Railway Age Gazette

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WE GUARANTEE, that of this issue, 7,680 copies were printed; that of these 7,680 copies, 6,155 were mailed or delivered by messenger to regular paid subscribers; 900 were distributed among members and guests of the American Railway Engineering Association and at the Coliseum; 500 copies were provided for office use to fill future orders; 75 copies were mailed to advertisers and 50 copies were mailed as samples.

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Engineers at the Valuation Hearing

The hearing on valuation principles before the Interstate Commerce Commission at Washington this week has prevented a number of the active members of the engineering association from attending the convention this year. As a result, a number of familiar faces have been missed, including those of past presidents W. C. Cushing, C. S. Churchill, E. F. Wendt and Robert Trimble, and directors G. J. Ray and W. D. Pence. Other members in Washington included G. W. Kittredge, chairman of the committee on electricity; C. F. Loweth, D. J. Brumley, W. H. Courtenay and J. E. Willoughby. It is unfortunate that the commission could find no other date for this hearing, but in reply to a letter from President Baldwin it was stated that the two weeks set aside were the only dates that could be set aside in advance of the summer adjournment, and the necessity of expediting the valuation work made a postponement of this length inadvisable.

Making Railroad History

Some of the most commendable pieces of work done by the association are to be found in the progress reports presented from year to year by several of the committees to record the progress of the art in the various lines with which they are concerned. As an example of this, may be mentioned the report which the Tie committee makes each year on service tests of substitute ties. As expressed by Chairman Downs of this committee, "This committee has stated on the floor many times we are building up a history of the ties of which we are very proud. It will go down to the young men 100 years from now who will loop up information as to how this substitute tie started." These remarks can be applied equally well to nearly all of the work which this association is doing. Although the organization is not yet 20 years old, the value of the Proceedings as an historic record has already been brought home to those who have had occasion to make researches in matters covered in its pages. The only regret to be expressed is that the association was not formed until the beginning of the twentieth century, for the absence of an equivalent body previous to that time is seriously felt in all studies of early railway practices. Although the railways of this country are less than 100 years old, many of the facts concerning the beginning of the American railways are lost beyond recall. The potential value of the transactions of this association for future research emphasizes the need of a thorough-going index such as is now in progress of preparation.

The Operating Aspects of Engineering

The work of the American Railway Engineering Association presents an interesting example of the present tendency of engineers to consider the operating aspects of their problems before determining final designs. Engineers were criticized with considerable justice years ago because of their tendency to ignore the operating phases of their work and their inclination to lay out their grades

and structures according to purely engineering standards. With the increasing demand for greater refinement in operating methods in recent years it has been necessary for the engineer to assume his share of the responsibility for improvements in facilities.

The committee on Economics of Railway Location has not only given much time to the determination of standards for the assistance of the engineer locating a new line, but it has also studied the economics of grade reduction which involves consideration of tractive power, draw bar pull, the efficiency of locomotives and other subjects not directly under the control of the engineering department. Likewise the committee on Yards and Terminals has been devoting much attention to the collection of data showing the relative cost of operation of flat and hump yards during the last three years. The correlation of the work in the engineering and operating departments will be further increased if the tentative proposal of the Board of Direction to form a committee on Economics of Railway Operation becomes effective. The opportunity for constructive work presented to such a committee will be one of the greatest confronting any committee of the association, while its conclusions should be of great value to the railways, dealing as they will with the very vitals of railway transportation.

MAKE THE TIME COUNT

When you stand in one of the Coliseum booths this week and put questions to a supply man about the application of his product to your requirements, do you listen to the band or idly watch the flashing lights across the room while he replies? We are told in confidence that some men—probably not many—have asked serious questions at the show, received serious and very complete answers, and then a few weeks or months later have written to the same supply man putting the same questions. Such a man is wasting his own time and that of the supply man. It requires effort, of course, to absorb anything of value from what one sees and hears at the big exhibit, but the effort is very much worth while, as any number of railway men will testify. The difference between wasting time and making it count lies largely in the mental attitude with which the railway man approaches the exhibit. If he has a serious purpose and a definite plan, he and his road will be well repaid for the time and effort spent in visiting the show. In order to offer a plan for studying the exhibit which will carry with it the serious purpose, we have announced a contest on what was learned at the exhibit.

This contest is being conducted jointly by the *Railway Age Gazette*, the Railway Maintenance Engineer and the Railway Signal Engineer, all published by the Simmons-Boardman Publishing Company. It is divided into two main parts, one on maintenance of way and one on signaling exhibits. Prizes of $50, $25 and $10, respectively, are offered in each of these main sections, and a single prize of $60 is offered for the best paper covering the exhibit as a whole. Any paper received which covers both maintenance and signal exhibits will be considered for the combination prize, and those that fail to win it will still be eligible for consideration in the two main divisions of the contest. It is understood that no individual will be awarded more than one prize. If the author does not specify whether his paper is primarily on maintenance or signaling, it will be placed in the group to which in the judgment of the editors it seems best suited.

The boards of judges, which will be made up of railway men, will make the awards on the following considerations: First, the practical value of the information which the writers present based on their study of the exhibit, and the extent to which the information will be of direct service to those who have not attended the display; second, the value of the suggestions offered to make the exhibit of greater benefit to railway men; and, third, the clearness and conciseness with which they cover the exhibit. In preparing these papers, it is desired that the writers treat devices and materials by classes rather than as the product of individual manufacturers, and that the names of companies be used only when necessary to make the meaning clear. The contest is open to anyone employed in railway service. Papers may be of any length, not exceeding 2,500 words. They should be mailed to the Editor of the *Railway Age Gazette*, 608 So. Dearborn street, Chicago, not later than April 9, 1917.

THE CONSTRUCTION OF EMBANKMENTS

At present is it the almost universal practice to build railway embankments with consideration only for the immediate cost of construction, and with little or no regard for the expense of maintenance later. The material closest at hand is used without reference to its adaptability for roadbed construction, and it is deposited in the most convenient way without any consideration of the possibilities of excessive sliding, settling, the formation of water pockets or a complication of kindred trouble later. The cost of maintaining a new embankment is naturally higher than that of an old, established roadbed, even under the most favorable conditions, but this excess cost has been increased needlessly in many cases by the manner in which the embankments have been built. It is not unusual for permanent relief and stable conditions to be secured only after the expenditure of a sum in excess of that which would have been required to place the embankment properly at first.

During the last three or four years a number of engineers have realized this condition more fully and they have endeavored to secure more information on this subject. The report of the Roadway committee describes an interesting experiment on the Bessemer & Lake Erie whereby 2½ miles of embankment built seven years ago were rolled thoroughly and where the cost of maintaining them is being compared with that of other embankments constructed in the ordinary way. The report also states that the Erie has volunteered to conduct two tests on embankments built in a similar manner. While time alone will show the full results of these practices it would appear that they should go a long ways towards preventing the formation of water pockets, one of the most serious enemies of sound embankments. A method of construction such as this should also reduce very greatly the amount of settlement and the consequent expense for maintaining the track in line and surface.

The Chicago, Rock Island & Pacific has adopted another plan to solidify the embankments which it is building on its track elevation work in Chicago, whereby the material is thoroughly soaked with water as it is placed, as a result of which it is expected that the entire settlement will be secured at once.

Not only does the continued settlement of an embankment add materially to the cost of track maintenance but on important lines carrying high speed traffic the elimination of slow orders is highly important. The magnitude of the expense which a road may feel justified in making to eliminate such slow orders is indicated by the method adopted by the Pennsylvania when it placed its new line at Bristol, Pa., in service three years ago. Because of the importance of this three-mile section in its New York-Philadelphia main line, the track was

placed in good condition before traffic was turned over it, and a speed of 30 miles per hour was permitted at once; this was gradually increased to 50 miles an hour and after one month to 70 miles per hour. This embankment had an average height of 22 ft., and to maintain it in condition for this speed $8,000 was expended in the first 10 days. The following month the forces were reduced, although the cost of maintenance was still $2,500 above normal the second month after the line was placed in service and it did not come down to normal until the line had been operated 6 months. Notwithstanding this the expenditure was considered justified because of the elimination of continued settlement and slow orders in a relatively short period.

The time has come when engineers must give more attention to the materials which they are placing in embankments, and particularly to the manner in which they are deposited. Although the construction engineer may not be called upon to operate the line after its completion, it is important that the lowest possible ultimate cost of both construction and maintenance be secured.

C. P. R. MEN AT THE COLISEUM

Thirteen Canadian Pacific roadmasters from the lines east of Ft. William (one from each division) and eight from the lines west arrived in Chicago Monday morning. They spent Monday forenoon in a study of maintenance conditions on the suburban district of the Chicago, Burlington & Quincy and the following afternoon and Tuesday at the Coliseum. The party was in charge of E. Keough, assistant engineer maintenance of way, lines east, and J. Clifford, assistant engineer maintenance of way, lines west.

JAPANESE VISITOR AT THE CONVENTION

Rioye Ono, civil engineer, with the Imperial Government Railways, Tokio, Japan, has been an interested attendant at the sessions of the convention the last two days. Mr. Ono is directly engaged in construction and maintenance work on these railways and is gaining much valuable information regarding American railway methods from his attendance at the convention. He has also visited the Coliseum, where he expressed himself as much impressed with the large number of practical exhibits. He has been in this country six months and expects to return to Japan in about a year.

THE EXCURSION ON FRIDAY

A revival of the excursions formerly participated in by the members of the assocation has been provided by a trip on Friday to Gary, Ind., and to Buffington, Ill., for the purpose of visiting the plants of the Illinois Steel Company, the American Bridge Company, and the Universal Portland Cement Company. Nearly 300 members and guests have already signified their intention of going, and accommodations have been provided for a considerably larger number. A special train will leave the La Salle street station Friday morning at 9 o'clock, going direct to Gary, Ind. A stop will be made at Buffington on the way out to let off any members who desire to visit the cement plant only.

The regular itinerary provides for a visit first to the plant of the Illinois Steel Company, with stops at the American Bridge Company shop and the cement plant on the return trip. The train is scheduled to arrive in Chicago not later than 6 p. m. Schedules of regular trains will enable members to return at an earlier hour if desired. A luncheon will be served on the train. The excursion has been arranged through the courtesy of the above named companies, which have extended an invitation to the members of the American Railway Engineering Association and their friends. Credentials can be had by application to the secretary's office.

N. R. A. A. BOARD MEETING

The board of direction of the National Railway Appliances Association, including both the old and the new members, will hold a meeting this morning at 11 a. m. in the secretary's office at the Coliseum.

TODAY'S PROGRAM

The convention will be called to order at 9:30 this morning.

Special.	Grading of Lumber	Bulletin 194
VIII.	Masonry	Bulletin 194
XV.	Iron and Steel Structures	Bulletin 195
XII.	Rules and Organization	Bulletin 195
XVII.	Wood Preservation	Bulletin 195
	New Business.	
	Election and Installation of Officers.	
	Adjournment.	

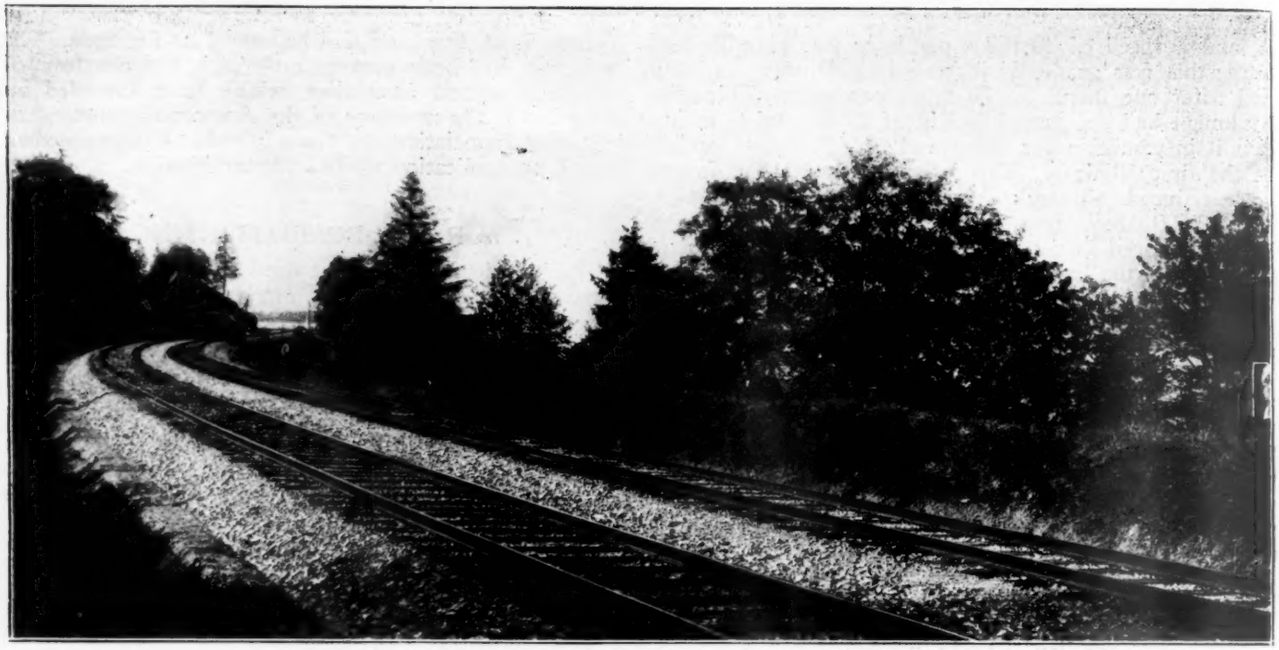
REGISTRATION AT THE CONVENTION

The comparative registration of members during the first two days of this convention and the same days for the seven previous years given below show that the registration this year is less than that for any of the preceding five years. At the same time the registrations have been better than many hoped for early in the week. Had not the threatened strike and the valuation hearing at Washington conflicted with this meeting the attendance would undoubtedly have exceeded that of any previous year.

	1910	1911	1912	1913	1914	1915	1916	1917
First day	210	286	355	336	356	331	386	289
Second day	87	51	76	102	112	109	107	140
	297	337	431	438	468	440	493	429

BARRETT COMPANY OFFICER TRANSFERRED

E. H. Poetter, who, as announced in the Daily Tuesday morning, has been transferred from manager of the general railroad sales department of the Barrett Manufacturing Company to the export department, was born on September 14, 1879, at Juneau, Wis. After graduating from the high school at Beaver Dam, Wis., in 1896, he took a business college course and in the same year entered the service of the Wisconsin Central as a stenographer in the land department at Chicago. He later became successively bill of lading clerk, chief clerk, contracting freight agent, and freight and passenger agent at Seattle, Wash., to which position he was appointed in 1903. In December, 1903, he returned to Chicago and for two years was engaged in the insurance business with the Equitable Life Insurance Company. In October, 1905, he entered the service of the Barrett Manufacturing Company as traffic manager at Chicago, in charge of the western territory. Later upon a change in the company's organization his title was changed to assistant traffic manager, with office at Chicago. On January 1, 1916, he was promoted to manager of the general railroad sales department at New York.



Railway Engineering Association Proceedings

Wednesday's Sessions, Including the Presentation of Several Committee Reports With Discussions

THE second day's session of the American Railway Engineering Association was called to order at 9:30 a. m. by President Baldwin, with an attendance considerably greater than that of the preceding morning. Reports by the committees were presented on track, ballast, ties, roadway, uniform general contract forms, economics of railway location, yards and terminals, records and accounts, buildings. Abstracts of these reports and of the discussions are given below. The reports of the committee on track and the committee on ballast brought out particularly complete discussions on those subjects.

Report of Committee on Track

THE committee recommends that paragraph 4, page 160, of the Manual be revised with reference to tools by adding the words, "tamping machines." (This suggestion is made since tamping machines have been used in sufficient numbers and for a long enough time to demonstrate their practicability. They should, therefore, be recognized as an approved tool for such work in broken stone ballast.)

G. J. Ray, Chairman

Economics of Track Labor

The committee advises that 20 railroads are reporting, in the prescribed manner, the results of the 76 test sections selected to represent varying climatic, traffic and roadbed conditions. The representation geographically is fairly good, with the exception of the Northwest, where it has been difficult to enlist the support of railways in keeping these records. The committee has results for nearly two years, and will now proceed to compile the figures and endeavor to strike some comparisons which will be of value, but owing to the fact that many of the influences which affect distribution of labor vary in intensity from year to year, we probably cannot obtain entirely conclusive results until data covering a longer period have been compiled. The committee has reached the following conclusions as to the manner of continuing the work: (1) Establish a relation between units of labor (man-hours) and the principal component parts of the roadbed and track, dealing with the individual roads alone. (2) Endeavor to make a comparison of such units as between roads having similar geographical position, climatic influences, traffic conditions and track characteristics. (3) Ultimately make a comparison of units of cost; this to be one of the later considerations.

The first, and most practical, result desired will be the establishment of ratios between man-days expended and units of the structure as a whole, such as the number of man-days required for the maintenance of a mile of main track or sidetrack, a railroad crossing, etc. It is expected that these ratios will establish a scientific plan for the proper apportionment of payroll expenditure.

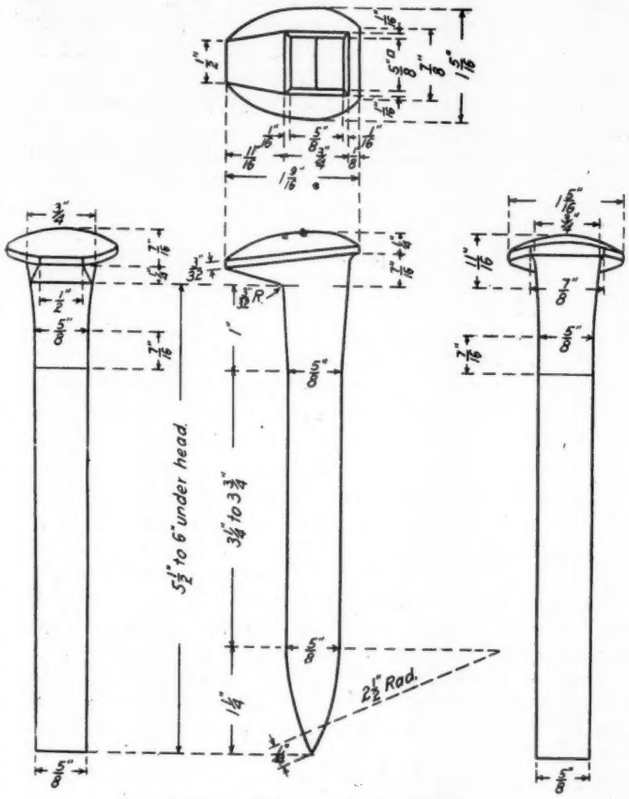
Specifications and Designs for Cut and Screw Spikes

Cut-Spikes

We submit a design for a cut-spike which we recommend be adopted by the Association. The head of the

cut-spike is designed to take the blow of the hammer directly over the axis of the spike and thus minimize the damage to spikeheads and the danger of breaking the head off during very cold temperatures. The tilting downward of the nose gives a stronger, more rugged construction, and assists in giving an easier clearance in the spike machine. It also permits the pulling of the spike more readily with the clawbar. The reinforcement is symmetrical; that on the back of the neck having been used originally as it now is with many roads to force the spike forward against the base of the rail when driving, but we have added the reinforcing on the front of the neck in order to give additional metal to withstand rail wear and necking of spikes, which has been prevalent with the old flat plate.

The present Association specifications for cut-spikes require that the physical tests be made on the finished



Proposed Standard Cut Spike

spike. There seems to be a tendency to have the tests made on the bars from which the spikes are manufactured. Therefore, the committee recommends the following changes in the specifications for ordinary Track Spikes:

Physical Properties and Tests.—Elongation not less than 20 per cent in 2 inches, *or if test is made on bar,* 25 *per cent in* 8 *inches.* When cold, the head of the spike must bend backward *till the under-side is in line with the body* without sign of fracture.

Workmanship and Finish.—The length under the head shall not be less than the dimension shown, nor shall it be greater than one-quarter of an inch more.

The committee submitted, as a matter of information, a cut of the so-called "Dog-Eared" spike. Those who have used this spike report most favorably on it. It is stated that the spike is especially well designed for use with shoulder tie plates, as it can be drawn more easily with the clawbar than the ordinary track spike. Furthermore, the additional metal in the head gives the spike a better resistance against corrosion. Where this spike is used it should have the same taper and general dimensions as the spike recommended by the committee.

Screw-Spikes

The committee submitted a design for a screw-spike. This form of spike is now in use by two or three roads making more or less use of screw-spikes and, so far as information is available, it has given satisfactory results. It will be noted that the distance from the underside of the head to the beginning of the thread is variable. This distance will vary with the thickness of the tie plate and rail base.

It is known by all concerned that the use of the screw-spike is very limited at the present time. The committee feels that now is the time to adopt a standard form of screw-spike so as to eliminate, as far as possible, the different forms of thread which are sure to be used as the use of screw-spike becomes prevalent. After a form of thread has once been adopted and generally used on any road, it would be a very serious thing to change the form or pitch of the thread, as new spikes could not be placed in old holes without destroying the thread in the wood.

It has been found, in practice, that trackmen when inserting screw-spikes are inclined to injure the wood fibers near the top of the hole by driving the spike farther than necessary with a hammer before applying the wrench. This trouble is aggravated by the ordinary stub-end on the spike. This difficulty is, to a great extent, overcome by extending the root of the spike beyond the thread line, with the thread cut away as it is on the shank of the spike under the head. Since this feature has been brought out only through a more or less extensive use of the screw-spike, and screw-spikes are now being extensively manufactured, it would seem to be advisable for the Association to recommend such a spike rather than the common stub-end spike generally used.

Again, where lines carry a large refrigerator business, it has been found that in the course of five or six years the ordinary square-head spikes will rust to such an extent as to cause considerable trouble in removing them, especially when wrenches are somewhat worn. This difficulty can be partly overcome by the construction of a rectangular head, with one dimension considerably greater than the other. Six or seven years ago the manufacturers of screw-spikes claimed that such a head would increase the cost of the screw-spike, but it is believed that this criticism will no longer prevail, and spikes similar to the one proposed are now being manufactured.

It has been found that screw-spikes ordered from two or three different manufacturers, to be made from a given design, will often differ so materially in dimensions as to make it impossible to use the spikes from one mill in holes made by screw-spikes from another mill without materially injuring the holding power of the wood. To overcome this difficulty it has been found necessary for inspectors to make liberal use of standard testing gages and only accept such spikes as will pass the test.

Therefore, the committee concluded to submit a design for a testing gage to correspond with the design of the spike proposed.

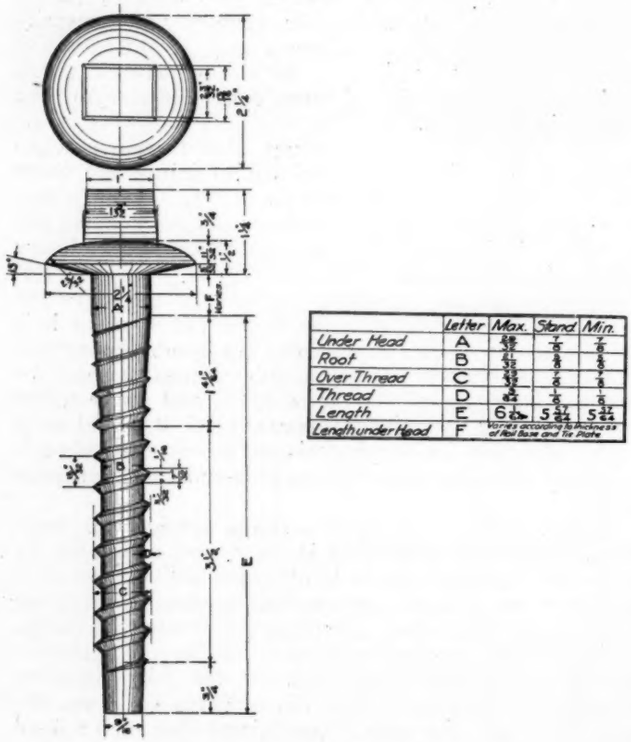
Guard Rails and Flangeways and the Effect of An Increase of One-Eighth-Inch Thickness of Wheel Flanges

The standing committee on car wheels of the M. C. B. Association reported in full on the above subject May

1, 1916. In this report the wheel committee, in concluding, made the following statement:

"Your committee is of the unanimous opinion that nothing would be gained in the interests of safety or economy by adding metal to any portion of the flange of cast-iron car wheels in such location as will in any way affect track clearances."

Following out our instructions, a joint meeting was held November 20, 1916, with the above committee of the M. C. B. Association, at which representatives of the Association of Manufacturers of Chilled Car Wheels were present. After a full discussion of the subject, it was very evident to this committee that the committee of the M. C. B. Association do not, at this time, intend to change their attitude as expressed in the above quotation from their report of May 1. Therefore, there seems to be no reason why the track committee should



	Letter	Max.	Stand.	Min.
Under Head	A	59/32	7/8	7/8
Root	B	41/32	1	1
Over Thread	C	33/32	7/8	7/8
Thread	D	1	5/8	5/8
Length	E	6	5 27/64	5 27/64
Length under Head	F	Varies according to thickness of Rail Base and Tie Plate		

Proposed Standard Screw Spike

further consider this question and, in view of the action of the wheel committee of the M. C. B. Association, we respectfully request that this committee be relieved of further consideration of the subject.

Design of and Specifications for Manganese Frogs and Crossings

The committee offers, as information, the following tentative plans and specifications for manganese frogs and crossings:

Manganese Steel Switchpoints

Manganese steel-pointed switches shall consist of rolled rail with the head cut away for a portion of the point and a manganese steel tip set thereon and attached to and supported by the web and base of the switch rail.

The manganese steel tip shall have an integral extension, or tail piece, running from the surface joint between the manganese steel and the rail, into the fishing section of the switch rail, the minimum length of such tail piece to be 10 in. and the minimum thickness ¾ in., thickened to at least 1 in. at the surface joint.

A reinforcing strap not less than ⅜ in. thick, fitting the fishing section, shall be provided on the opposite side of the web of the rail, extending along the full length of the manganese steel tip and beyond the end of the side-head planing of the switch rail.

The top of the surface joint, between the manganese steel and the rolled rail, shall be at least ⅛ in. below the head of the stock rail. Where the stock rail is worn considerably a new stock rail should be installed with a new switchpoint to assure the joint between the manganese tip and the rolled rail coming below the running surface.

The end of the point shall be ½ in. below the top of the stock rail and rounded off with a radius of 1½ in. It shall be shaped by grinding from a theoretical distance of $\frac{5}{16}$ in. between gage lines to a thickness of $\frac{1}{16}$ in. on the top line. A depth of 1⅞ in., measured from the top of the stock rail, shall be provided for clearance of the wheel flanges, on any parts of the manganese steel or reinforcing bars projecting below the path of the wheel flange.

The thickness of the vertical member of the manganese steel tip adjacent to the rail web shall be a minimum of $\frac{9}{16}$ in. at the point, increasing toward the joint.

The minimum length of manganese steel tips, measured from the actual point to the surface joint on the gage line shall be 2 ft. for switches from 10 ft. to 12 ft. in length, inclusive, and 2 ft. 6 in. for all switches over 12 ft. long, used under ordinary conditions. On curved switches, or under special conditions of severe side wear, longer tips may be required. Variations from the lengths recommended may also be required by rod and tie spacing in individual cases.

Castings

Chemical Analyses and Physical Tests.—Chemical analyses and physical tests, when required, shall be in accordance with standard specifications hereinafter given.

Designs and Proportions.—Castings in their general proportions and distribution of metal shall be within the standards given in Vol. 16, pp. 718-727. Sharp angles in castings are not permissible; all must have fillets.

General Conditions.—Castings shall be reasonably smooth and true to pattern in accordance with good foundry practice. Large lumps, sharp fins, sand and chills on the outside of the castings shall be removed. The castings shall be free from such blowholes, sandholes, cracks, cold shuts or other defects which would impair their serviceability and as further specified below. Castings must be out of twist and reasonably true, both as to general surface and alinement, and must not show any signs of straining or undue denting produced in the straightening process.

Imperfections.—Tread surfaces within 2½ in. of the gage line and the side of the groove 1 in. down from the tread shall be free from physical defects, such as shrinkage cracks, sandholes, blowholes, cold shuts or segregation of metal, unless such defects are so small that they have been practically removed by the finish grinding, and there must be no indication of unsoundness of the metal. Shrinkage cracks, cold shuts or segregation of metal will not be allowed in any part of the tread surfaces. Sandholes, blowholes and cold shuts in portions of the casting where they will not appreciably weaken the casting, or impair its wearing qualities, will be permitted. Castings must be free from shrinkage cracks running vertically in web members of solid work or horizontally at or near the ends or in corners of junction of projecting members, or longitudinally in grooves.

Other small shrinkage cracks which do not materially weaken the casting will be acceptable within the following approximate limits:

In guards across the tops not extending more than ¾ in. downward.

In bottom flanges of solid work not extending from the edge through more than half the width of the flange.

In vertical members of rail-bound work extending not more than ¾ in. upward from the bottom.

In bottom of groves transversely not extending beyond the lower fillet.

Horizontally in web members not at or near the ends.

A casting with two cracks in close proximity to each other, or nearly opposite on the two sides of the casting, will not be acceptable.

Welding.—No electric arc or other welding will be permitted on the running surfaces. Imperfections in other parts not affecting the strength may be welded to improve the appearance.

Finish

Running Surfaces.—Running surfaces of manganese steel castings shall be finished to be practically the same as those of rolled rails. Variations from true level are not to be more than $\frac{1}{16}$ in. in 5 ft. of length of casting, and not more than ⅛ in. in the total length of the structure. Where the side of the casting lies up against rails, it must be a good fit, with no opening more than $\frac{1}{16}$ in. wide at any point.

Grooves.—Grooves in manganese steel castings shall be of standard contour and with top fillets at the ends to match connecting rails. The width of grooves measured ⅝ in. below the running surfaces must not be narrower and not more than $\frac{3}{32}$ in. wider than the specified width. Grooves may be $\frac{3}{16}$ in. deeper, but not more than $\frac{1}{16}$ in. shallower than standard.

Joints.—Where castings connect directly with rails, the joints shall be finished for a tight fit of standard angle bars throughout the length of the joint plate and projecting portions of castings to take the place of joint plates shall be finished to a fish-plate fit. When joints are bolted up tight, the rails shall align correctly with the casting, with no greater variation than $\frac{1}{32}$ in. in either line or level. Special joints may be used between castings, but they must be equally well finished. The top edges of the castings at the joints shall be sharp and square with the gage line. Openings not more than $\frac{1}{16}$ in. wide between the side of the rail head and casting and not more than ⅛ in. wide between lapping portions of abutting castings shall be permissible. Open joints between rails and the casting shall not exceed $\frac{3}{32}$ in., and between castings shall not exceed $\frac{3}{16}$ in.

Bottoms of Castings.—Where castings rest on the bottom flanges of rails, they shall conform to the angle of the flange of the rail and have a continuous bearing thereon. The bottom parts of the castings which rest on ties shall be reasonably straight and out of twist, with no greater variation than ⅛ in. in 5 ft. from a true plane, and shall be free from lumps or such imperfections as would prevent a good bearing.

Variations from Dimensions

Gage Lines.—The gage lines shall be true, no variation of over $\frac{1}{16}$ in. being permitted in line, and any variation in the width of grooves shall be confined to the guard line.

Length.—The over-all length of standard frogs shall be as specified, with an allowable variation of ⅛ in. under size to $\frac{1}{16}$ in. over size. In special frogs and crossings a variation of ⅛ in. shorter or $\frac{3}{16}$ in. longer for each 10 ft. in length shall be allowed; in cases of two or more abutting pieces, the above tolerance shall apply to each 10 ft. of the combined length, individual pieces thereof may exceed the limits.

Spread of Angles.—One-eighth inch wider or ⅛ in. narrower between gage lines at the extreme ends of arms shall be allowed.

Gage in Crossings.—One-eighth inch wider or ⅛ in. narrower than specified gage shall be allowed. Distance between guard lines shall not exceed the specified gage less twice the specified width of flangeway.

Fish Plate Holes.—The spacing in solid frogs and crossings shall not be more than ⅛ in. out of true position, either vertically or horizontally, and on rail-bound work not more than $\frac{1}{16}$ in. out. The size of holes in solid manganese steel work shall not be more than ⅛ in. over size; in rail-bound work not more than $\frac{1}{16}$ in. over size. Fish-plate holes shall be free from fins, burs and lumps.

Marking.—All structures shall be provided with a permanent mark by which the maker can be identified.

Specifications for Manganese Steel

Chemical Composition.—The chemical composition of cast manganese steel shall be within the following limits:

Elements.	—Percentages— Not Less Than	Not More Than
Manganese	10.00	14.00
Carbon	1.00	1.40
Phosphorus	....	.10

Drillings from the finished articles shall be furnished to the inspector from time to time on request for check analysis.

Phyisical Qualities.—A rough cast specimen ¾ in. by ½ in. shall bend cold on the flat side around a diameter of 1 in. to an angle of 180 deg. without breaking. The bending may be accomplished by pressure or by blows. Bending test demonstrations from test bars poured from the same heat as the castings, when required, shall be made in the presence of the inspector at the foundry where the castings are made.

Railbound Manganese Steel Frogs, Applicable to All Frogs Up to and Including No. 20, for All Rail Sections from 80 Lb. per Yard Up, and from 2⅜ In. to 3 In. Width of Head

The following principles and standards are embodied in and form part of the design:

Dimensions and proportions of manganese steel casting to be equal to or better than those shown in Vol. 16, A. R. E. A. Proceeding, p. 720, drawing No. 2.

Shape of point to be same as shown on page 721, drawing No. 3.

Heel block extension to be same as shown on page 723, drawing No. 5.

Groove to be same as standard.

Flare in manganese steel wing to be same as standard (lengthened in frogs above No. 9).

Wing rails to be kept to full section without notching or planing and to be on straight line, parallel to gage line, as far as possible.

Fillers between heel rails and wing rails to have parallel sides and to be alike for all angle frogs for same rail section.

Through bolts to be 1⅜ in. in diameter for rails with a fishing section over 3⅜ in. high; 1¼ in. diameter for rails with fishing section over 3 in. high up to and including 3⅜ in., and 1⅛ in. in diameter for rails with fishing section less than 3 in. down to and including 80-lb. rails; height of fishing section to be measured on vertical center line of rail.

Through bolts at heel and toe, as indicated on drawings, to be of high-tensile steel.

Quality of material and finish to be as per above specifications for manganese steel track work for steam railroads.

Rules for Laying-Out Design

Toe End.—Place wing rail parallel to gage line at a constant distance of 4 in. from the gage line for all frogs. Run out the line of the head of the wing until it meets the gage line of the toe rail, which will be at a spread of

$$\frac{4 \text{ in.}}{\text{Cos. } \frac{1}{2} \text{ Frog Angle.}}$$

If the angle is 1 in 8 (No. 8 frog) or greater, this will be the end of the manganese at the toe. If the angle is smaller than 1 in 8, introduce a reverse bend in the wing rail, giving an angle of 1 in 8 for a constant length for all frogs (above a No. 8) of 15 in., thereby reducing the spread of manganese at the toe end to

$$\frac{4 \text{ in.} - (15 \text{ in. by sin. [7 deg. 10 min.—Fr. Ang.]})}{\text{Cos. } \frac{1}{2} \text{ Frog Angle.}}$$

Shape manganese to a point, laying close to the head of the rail at the bend.

Manganese Wing and Flare.—Run manganese wing parallel with the gage line of the point of frog 2¼ in. wide for a 1¾ in. flangeway and correspondingly less for wider flangeways. Commence to flare opposite the point where the spread of the gage line is 2¼ in. Introduce flare for 1¾ in. flangeway as a minimum. If this brings the end of the flare (16 in. from the point of commencement) opposite a point where the spread of gage lines is less than 4 in. (above a No. 9 frog), then extend the flare by placing the outside end at the 4-in. spread; go back 6 in., reducing opening from the 3¾ in. at the extreme to 2½ in. in that distance; then reduce the width of opening by a straight line from the 2½ in. to the regular 1¾-in. width of flangeway at the point where the spread of gage line is 2¼ in.

NOTE—For flangeways wider than 1¾ in., the length of the second part of the flare will be shortened correspondingly.

Heel.—From the end of the flare in the manganese wing, carry manganese across the 4-in. opening between the head of the wing rail and the gage line on an angle of 30 deg. If this meets the gage line of the manganese point at a spread of 5 in. or greater, the end of heel rail is placed at that point (No. 8 frog and below). If the spread is less, then extend the manganese a length necessary to bring the spread to 5 in. for the point where the heel rail commences, and also extending manganese flangeway, but without changing the position of the end of the flare.

Heel Block.—The heel block extension between heel rails to run 6 in. beyond a 7½-in. spread between gage lines with a minimum length of 28 in. from the point end of heel rail (No. 9 frog and below).

Heel Rail.—The heel rail is offset in the web by a reverse bend in a length of 10 in., commencing 15 in. from point end of the rail; the amount of the offset being a distance equal to one-half the width of the head of the rail minus ⅞-in., bringing the center line of the web ⅞ in. from the gage line and running parallel for 15 in. at the point. The head on the gage line is planed to a straight line after bending, conforming to the side contour of the head. The back of the head is planed on a straight line after bending, conforming to the side contour of the head. The back of the head is planed on a straight taper with the vertical side for 1½ in. total width of head from gage line at the point end to full section at the end of the heel block. The back of the point end is rounded by a 4-in. radius. The wing rail laps the heel rail a constant distance of 15½ in.

Bolt Spacing.—Figures for positions of bolts and spacing, underscored on drawing, are constant for all frogs and are measured on the gage line. Through bolts between the ends of the manganese wing to be spaced in the least number of equal spaces between fixed positions of end bolts, giving not over 12-in. center. Spacing of bolts through the fillers is constant, as shown. Bolts through heel block—not less than two bolts beyond end of wing rails and three bolts where wing and heel rails overlap. Bolts between the fixed positions of bolt at the end of heel blocks and the first bolt outside of the end of the wing rails to be spaced equally and not more than 10 in., center to center.

Bearing of Manganese Steel Casting on Rails.—The bottom bearing of the manganese steel casting on the bottom flange of the wing rail to be continuous throughout the main portion of the wing rail, which is parallel to the gage line and for a length of 4 in. at the extreme toe end. The bearing under the head and against the web of the wing rail to be continuous for a length of 4 in. at the extreme toe end, and then for a length of 3 in. at each through bolt up to and including the first bolt beyond the theoretical point and at every other through bolt between the theoretical point and the end of the flare in the manganese wing, but not beyond the end of the flare. When this arrangement of bearing points brings a bearing at the first bolt ahead of the heel filler, omit such bearing and place it at the next bolt toward the point instead. Heel rails are to fit manganese steel in the fishing section, except within the length of the bend for offset of web.

Heel Fillers and Toe Block.—Cast-iron filler blocks between heel rails and wing rails are a constant length of 14¾ in., measured on the gage line and extended along the wing rail to near the end of the manganese steel. A cast-iron toe block 7 in. long is placed 2 in. from the end of the manganese steel and is provided with one through bolt. Fillers and toe block to fill sections of rails with rough fit.

Optional Features

Length of Frogs.—Frogs are to be made any length specified, providing toe rails extend beyond the toe block and heel rails beyond the end of the heel block a sufficient distance to allow for length and clearance of splice bars used.

End of Wings.—The end of the wings is cut vertical unless a bevel end is called for, when it is to be beveled at 45 deg. from the vertical with the filler and outside washer cut to same bevel.

Foot Guards.—Frogs to be foot guarded when required, in accordance with the specifications of the purchaser.

SUBJECT No. *7-b*

REDUCING THE PRESENT ALLOWABLE LIMIT FOR FLAT SPOTS ON FREIGHT CAR WHEELS

The committee endeavored, through the President of the Association, to confer with the M. C. B. Association with respect to the allowable limit for flat spots on freight car wheels. C. E. Chambers, president of the Master Car Builders' Association, advised President Baldwin by letter of September 1, 1916, that the executive committee of the M. C. B. Association were of the unanimous opinion that the present limit of 2½ in. should not be reduced, and that the matter could not be taken into consideration without first being referred to the entire Association. Mr. Chambers further stated

that to reduce the size of the allowable flat spot would mean a tremendous expense to the railroads by way of changing and scrapping wheels.

The committee is of the opinion that this question is one of importance to the maintenance department, and should be further considered. We do not concede that a reduction of the present allowable flat spot, say from 2½ in. to 1½ in., would mean any considerable expense to the railroads. It is most certain that a wheel with a 1½-in. flat spot will travel but very few additional miles until it reaches the present limit of 2½ in. The additional expense on account of changing and scrapping such wheels with a flat spot limit of 1½ in. can only be measured by the additional mileage secured by wearing the wheel until it reaches the 2½-in. limit. It goes without saying that the greatest damage to track fixtures will be caused while the wheel is making these few additional miles.

The damaging effect of flat wheels upon rail has long been recognized, and means were taken to limit the evil by the M. C. B. Association 38 years ago (1878). At that time the allowable length of flat spots on car wheels was fixed at 2½ in. It has remained the same to the present time with freight car wheels of 33-in. diameter. From time to time attempts have been made to decrease the length allowed, as the weight of the car and lading have been largely increased. As a matter of fact, the freight car axle load has now reached 52,500 lb., or an amount equal to the entire freight car load at the time the above rule was put into effect.

The committee is of the opinion that the joint committee on Stresses in Railroad Track should eventually consider and report on this question of flat spots on freight car wheels, and we respectfully request that the Board of Direction consider the advisability of so arranging.

Test of Tie Plates Subject to Brine Drippings

The committee experienced some delay in starting this test on account of the inability to get the rolled steel plates. They were finally obtained August, 1916. Plates were installed on September 1, 1916, in the tracks of the Chicago Junction Railway, where they are subjected to almost continual movements of refrigerator cars. The track was renewed with new ties and rail at the time of their installation, and each plate was carefully weighed and numbered. The plates are of malleable iron, rolled steel, wrought-iron and pure iron.

Twenty of each kind of plates were treated with crude oil at a temperature of 400 deg. F. and left in the oil for a period of five minutes. Twenty of each were treated or dipped in coal tar at a temperature of 400 deg. F. and left in the tar for a period of five minutes. Ten of each (of the untreated plates) were held for chemical and physical test. Two of each of the untreated plates are to be taken out of the track the first of each month, carefully weighed and preserved until the test is completed. One oil and one tar treated plate is to be taken out every three months.

There are on an average of 700 cars per day passing over the track, of which 360 are refrigerator cars. These, however, are known as through cars, and do not include refrigerator cars which are being switched almost constantly twenty hours each day. This report is necessarily one of progress only.

Limit of Wear on the Rail Head on Curves

A circular letter was sent to the roads represented in the Association, for the purpose of ascertaining the general practice with respect to rail wear on curves. In the opinion of the committee, based on experience and the replies received to the above circular, it would not be advisable to fix any general rule by which the allowable limit can be fixed. On some roads it is the practice to interchange the low and high rails in curves long before either rail has reached its limit of wear. This method is generally conceded to be both safe and economical, since a greater percentage of the rail head can be worn away before reaching a dangerous limit of wear. Again, much depends on the rail section, quality of steel, weight of wheel-loads, class of traffic, and quality of roadbed. The committee, therefore, believes that no rule should be given, and recommends that each road decide this question on local conditions.

To What Extent Are the Frog and Switch Designs Recommended by the Association Being Used by Railways

The committee sent out a circular letter to the members of the Association to ascertain the extent to which the frog and switch designs, and other recommended practices, included within the scope of the Track committee, are being used by the railroads represented in the Association.

While no one of the 62 roads replying has adopted the A. R. E. A. standards in all cases, many are using them as a guide with slight modifications made to meet local conditions. Many railroads have established standards and report that on account of the expense involved to make the change they have not adopted the A. R. E. A. standards as a whole; they state that as far as practical in general maintenance of way work it is the policy to use the recommended standards, but that it is not practical to make sweeping changes in the previously adopted standards. In new construction work many are using the A. R. E. A. standards almost exclusively and believe they represent the best engineering practice.

Definition of Main Track

Full consideration of the subject brought out the fact that other definitions were needed in order to fully establish a definition for "Main Track," and accordingly the committee submits four definitions, as follows:

(1) Main Line.—The principal line or lines of a railway.

(2) Branch Line.—The secondary line or lines of a railway.

(3) Spur.—A line of railway diverging from a main or branch line over which no regular train service is maintained.

(4) Main Track.—The running track of a railway whereon the movement of trains is controlled by timetable, train-order, or block signal.

For multiple main tracks, the southerly or easterly main track shall be designated as the first main track, the adjacent one as the second main track, etc.

The committee recommends for next year's work:

Continue the study of the economics of track labor.

Report on typical plans of turnouts, crossovers, slip switches and double crossovers, and prepare detail plans for such work, including such incidentals as tie plates, rail braces, riser plates, etc., conferring with the committee on Signals and Interlocking.

Report on the reduction of the taper of tread of wheels to 1 in 38 and on canting the rail inward.

Report on the test of tie plates subject to brine drippings.

Report on specifications for relayer rail for various uses.

The committee further recommends that the subject with reference to the advisability of reducing the allow-

able flat spots on freight car wheels be turned over to the special committee on Stresses in Railroad Track.

Committee: G. J. Ray (D. L. & W.), Chairman; H. R. Safford (G. T.), Vice-Chairman; A. F. Blaess (I. C.), M. C. Blanchard (A. T. & S. F.), Geo. H. Bremner (I. C. C.), H. M. Church (B. & O.), Garrett Davis (C. R. I. & P.), W. R. Dawson (N. & W.), A. L. Grandy (P. M.), G. W. Hegel (C. S.), T. H. Hickey (M. C.), E. T. Howson, *Railway Age Gazette;* L. J. F. Hughes (C. R. I. & P.), E. L. Ingram, University of Pennsylvania; T. T. Irving (G. T.), J. B. Jenkins (B. & O.), J. R. Leighty (M. P.), H. A. Lloyd (Erie), A. C. Mackenzie (C. P. R.), J. V. Neubert (N. Y. C.), R. M. Pearce (P. & L. E.), H. T. Porter (B. & L. E.), L. S. Rose (C. C. C. & St. L.), C. H. Stein (C. R. R. of N. J.), A. H. Stone, W. P. Wiltsee (N. & W.).

Discussion

Mr. Safford (representing the chairman): The first subject considered by the committee was to "Make critical examination of the subject-matter in the manual and submit definite recommendations for changes."

Mr. Safford: I move you, Mr. President, that paragraph 4, page 160, of the manual be revised with reference to tools by adding the words tamping machines.

(Motion seconded and carried.)

J. C. Nelson (S. A. L.): The committee speaks of broken stone ballast. Has there been any investigation of these machines in the use of gravel?

Mr. Safford: So far as I am able to say, subject to correction by Mr. Howson, practically all of the experimental work done with these machines up to this time has been with stone ballast. I think I am safe in saying that the committee intends to give some further study to this matter as a current subject, and with especial reference to its application to gravel ballast.

Mr. Nelson: In our section of the country we have to wash all of our gravel, but if we screen the sand out of it, according to the specifications of this association, my men have brought the subject up as to whether that would be applicable to gravel ballast. I trust the committee will consider this phase of the subject next year.

C. E. Lindsay (N. Y. C.): I have a number of machines in use, and from our experience we know that they are applicable for use in connection with gravel ballast, the only change being the need for a little wider tube.

Mr. Safford: Has Mr. Howson anything to say on this part of the report, as chairman of the sub-committee?

E. T. Howson (Ry. Age Gazette): The idea of the sub-committee in making this recommendation was that the information which we secured led us to understand that the tool had been used primarily in stone ballast up to the present time and that its practicability for that use had been demonstrated. The committee did not have information at the time this conclusion was reached which would justify it in making any recommendations regarding gravel ballast. As the chairman has said, that was left for future consideration.

Mr. Nelson: The matter is in a rather misleading state, in view of the statement of Mr. Lindsay. Those of us who have had no experience with the machine would be rather disinclined to use it for gravel ballast, when the association has practically limited its use to stone ballast.

Mr. Safford: The committee does not recommend putting this into the manual at this time, even in reference to its use for broken stone ballast. The object of the recommendation is merely to introduce the term "tamping machines."

Mr. Nelson: I thought you intended to incorporate this recommendation now as a standard.

Mr. Safford: That is merely a parenthetical note.

Mr. Nelson: I will withdraw my comments. Your explanation is satisfactory.

Mr. Safford: The second subject assigned to the committee is "Continue the study of the economics of track labor."

This part of the report is a report of progress only.

The President: Unless there is objection this part of the report will be received as information.

Mr. Safford: Subject No. 3, which was assigned to the committee, is "Report on specifications and submit designs for cut and screw spikes."

A slight change in the printed recommendation has been approved by the committee since the bulletin was issued, and I will read the corrected wording. Instead of the proposed paragraph on page 404, under "Physical Properties and Tests," the following should be substituted: "Elongation not less than 25 per cent in 2 inches, or, if test is made on bar, 20 per cent in 8 inches."

This change was suggested by a member of the committee and later was discussed with a number of engineers of tests, and was suggested primarily because of this fact: The elongation locally developed in the vicinity of the final rupture, or in the necking-down of the metal, is nearly the same for all lengths of specimens. Elongation uniformly distributed over the specimen is directly proportional to the length. Therefore, the percentage of elongation is greater for short specimens than for longer ones.

I would therefore move you, Mr. President, that the revision of the manual shown under the heading, "Physical Properties and Tests," be adopted as read.

C. E. Lindsay (N. Y. C.): Under "Physical Properties and Tests," the committee undertakes to change the wording of the second paragraph. I believe that this should read: "When the head of the spike is bent backward cold until the underside is in line with the body, it shall show no sign of fracture."

The President: Is there any further discussion with reference to this specification?

C. W. Baldridge (A. T. & S. F.): I ask why, if it wishes to change the wording of the amount of bending it shall undergo, the committee does not use the same method usually applied and say that it shall bend so many degrees without signs of fracture?

Mr. Safford: In the actual handling of the manufacture of the spike, that is a more practicable method than to specify the number of degrees.

The President: The vote will be put first as to the adoption of the specification as distinguished from the design.

Mr. Safford: I might say, Mr. President, that this suggested design, if I remember correctly, has been before the association for years. This is the first time, to my knowledge, when a suggestion has been made that it was not practicable to construct the spike as shown by the plan.

Earl Stimson (B. & O.): Having had the experience we have had I believe the matter should be referred back to the committee. We made every effort to get the manufacturers to accept that design, but it was an impracticable design to be made on machines. For that reason I move that the report, in this respect, be referred back to the committee.

Mr. Lindsay: Not only is the head impracticable, as I understand it, but the shape of the point, composed of two curves—it is not an economical, well-designed device.

John V. Neubert (N. Y. C.): In regard to the matter of design, I will say that Mr. Ray had this same thing

submitted last year, and he suggested to me we would not make any change in it at all this year.

In regard to the manufacture of the spike, he said that he had taken the subject up with the manufacturers, and they told him that they could make this spike, and he has drawn up these specifications. That is the reason the matter is submitted in this way.

J. G. Sullivan (Can. Pac.): We are using a spike very similar to this, with the exception of the point raised by Mr. Lindsay, that the points are made by the intersection of two planes rather than curves.

F. E. Abbott (Lackawanna Steel Co.): This design, as I understand it, would necessarily have to be made on a hand machine. That is a slower process and necessarily the cost runs up in the manufacture. Unless the particular shape of the head, with the reinforcement, as there arranged, and the curved point, would be of very special advantage to the user, it would be to the interest of all concerned to modify the design so that the spike could be made on automatic machines, by which process they can be produced so much faster and at a necessarily less cost, so that the users, as well as the manufacturers, would get the benefit of that,

Mr. Safford: Has your company made any spikes with these two features incorporated in them?

Mr. Abbott: No, we cannot make them on an automatic machine. They require a hand machine.

Mr. Safford: How about the additional length of metal in the neck?

Mr. Abbott: I am not so sure about that, we can make a reinforcement on one side or the other, but, as I understand this specification, it calls for a reinforcement on both sides, and the difficulty in the head is that there is not clearance enough between the hammer and the dies—you must have sufficient metal between the dies and the hammer in order to avoid breaking the dies. That accounts for the little metal which appears in the back part of the head, and there must be enough clearance there to save the destruction of the machine.

Mr. Safford: There is no doubt that it would be very desirable to get the additional metal at the top of the spike, because there is where the greatest reduction in section comes in actual use.

Mr. Stimson: I would be in favor of the adoption of this standard only on condition that the committee can assure the association it can be made at practically the same cost as the other design.

J. L. Campbell (E. P. & S. W.): I wish to emphasize what has been said in regard to the desirability of having all of our standards practicable ones, as nearly as may be, so that they may be used very generally. It is highly desirable that the matter be referred back for further consideration.

Geo. H. Bremner (I. C. C.): I may say at this point that the matter of practicability of manufacture was considered by the committee: There apparently is nothing in the design of the spike for which an automatic machine could not be made to stamp the spike out. Naturally, the machines which are now in existence probably would not do it, but new machines would, and manufacturers have assured Mr. Ray it can be done and that they would make the spikes.

Mr. Neubert: I talked with Mr. Ray in regard to the design of this spike, and he told me that the only objections raised were in regard to the points. Members of the committee took the matter up with the manufacturers and they said the spike could be made.

(The motion was put to vote and carried.)

Mr. Safford: The next subject is with reference to "Workmanship and Finish."

C. E. Lindsay: I think this should be changed to make the wording read as follows:

"The length under the head shall be not less, and not over one-quarter inch more, than the dimension shown."

Mr. Safford: The committee will accept that.

J. L. Campbell: I will suggest that we are now considering oversize.

The President: The motion before the house is that the matter under "Workmanship and Finish" with the suggestion made by Mr. Lindsay, which has been accepted by the committee, be approved. (Motion put and carried.)

(Mr. Safford then read the matter under "Screw Spikes," beginning on page 404 and ending with the words "being manufactured" on page 405.)

Mr. Safford: I move that that paragraph, including the design, be adopted.

Mr. Lindsay: I move that that design be modified to make the thickness of the upper edge $\frac{3}{32}$ of an inch. (Motion seconded.)

Mr. Safford: I think that is a dimension which could be left on this drawing, and the very small detail could be changed if the roads so desire.

The President: You have heard the motion. Those in favor of adopting the design and specifications for the screw spike will signify by saying aye. (Motion carried.)

Mr. Safford: The committee submits a drawing "Testing Gages for Screw Spikes." I move that that be adopted. (Motion carried.)

After brief discussion, reports on subjects 4, 5 and 6 were accepted by the association as information.

Mr. Safford: The next is Subject No. 7-b, "Confer with Committee of M. C. B. Association with a view of reducing the present allowable limit for flat spots on freight car wheels." Your committee merely suggest at this time that this action be considered by the Board of Direction. This report is merely one of progress, together with the suggestion that as it affects stresses in rail and stresses in track, these circumstances ought to be considered by the special committee appointed for that purpose.

The next is Subject No. 8, "Report on Test of Tie Plates Subject to Brine Drippings." The committee merely reports progress made with these tests.

Subject No. 9, "Report on limit of wear on the rail head on curves." The committee feels that this is a subject that cannot be brought to such a point that a definition or recommendation for the manual should be made. As stated by the committee, there are too many factors entering into this problem to make it either practicable or safe for this association to specify an allowable wear which should be reached before a rail is taken out of any individual class of service. The factors which affect that principally are traffic, speed, the character of the track and general standard of maintenance. The committee therefore wishes to state that it ought not to be expected to do anything more on this subject.

The President: Unless there is objection this recommendation will be accepted, and the report as made will be printed in the proceedings.

Mr. Safford: The next is Subject 10, "Report on specifications for relayer rail for various uses." The committee is studying this matter, has made some progress, but is not able yet to make a definite report.

Subject No. 11, "Report to what extent the frog and switch designs recommended by the association are being used by railways." (Mr. Safford then read all of the paragraphs under this subject.)

The next is Subject 12, "Report on definition of 'Main Track.'" The committee submits four definitions. (After extended discussion these definitions were adopted for insertion in the manual and the committee was dismissed.)

Report of Committee on Ties

A SERIES of questions was submitted to a number of railroads, the purpose of which was to develop, if possible, the cause of failure to protect the tie. The committee felt that a study along this line might develop the reasons for the rapid changes in design that have taken place. A summary of 39 replies is given below:

L. A. Downs, Chairman

Question No. 1. Are the tie plates now in use and used prior to this date on your track giving entire satisfaction? Twenty-seven roads report their present plates satisfactory, 11 roads report their present plates unsatisfactory, and 1 road made no report.

Question No. 2-A. Have you had any failures to fully protect the tie, from mechanical wear? Twenty-three roads report yes, 15 roads report no, and 1 road made no report.

Question No. 2-B. Have you had any failures to fully protect the tie, by inducing more rapid decay? Twenty-one roads report yes, 16 roads report no, and 2 roads made no report.

Question No. 2-C. Was the cause of failure due to insufficient strength of the tie plate itself? Twenty-six roads replying to this question report yes, 9 roads report no, and 4 roads made no report.

Question No. 3. Which of the three causes of failure enumerated above has occurred most frequently, and is, in your opinion, most serious? Twelve roads report "mechanical wear," 6 roads report "inducing more rapid decay," 15 roads report "insufficient strength of the tie plate itself," and 6 roads made no report.

Question No. 6. Have the type of fastenings (screw or spike), in use, given entire satisfaction? Cut-Spike: Twenty roads report yes and 15 roads report no. Screw-Spike: Six roads report yes and 1 road reports no. Four roads reported on both cut-and screw-spikes, and 1 road made no report.

Question No. 7. What kind of rail fastenings do you use? Thirty-five roads use cut-spikes, 8 roads use screw-spikes, 2 roads made no report, and 6 roads reported on both screw- and cut-spikes.

Question No. 8-A. Have you had any failures to fully protect the tie from mechanical wear? Twelve roads report yes, 16 roads report no, and 11 roads made no report.

Question No. 8-B. Have you had any failures to fully protect the tie by inducing more rapid decay? Eleven roads report yes, 18 roads report no, and 10 roads made no report.

Question No. 8-C. Have you had any failures to fully protect the tie by reducing the strength of the tie? Ten roads report yes, 18 roads report no, and 11 roads made no report.

The study of the effect of tie plates and fastenings on the life of cross-ties leads to the following general conclusions:

(1) The principal cause of failure to protect the tie has been due to insufficient area and thickness of the tie plate.

(2) That a design of tie plate with an equal bearing surface on each side of the rail has proven unsatisfactory.

(3) That to protect the tie properly, movement between the tie plate and the tie must be eliminated as far as practicable.

(4) The committee does not believe that, in general, the plates now considered satisfactory have sufficient excess strength to prove satisfactory throughout their life, under normally increasing wheel-loads and traffic conditions.

(5) That projections on the bottom of the tie plate should not be greater than $\frac{3}{16}$ in.

Sufficient data have not been collected by the committee for it to present any definite conclusions as to the effect of fastenings on the life of ties, but their further investigation only confirms the previous judgment of the committee, that the use of cut spikes driven without boring holes not only hastens decay, but seriously impairs the strength of the tie by the destruction of the wood fibers, and that a properly designed screw-spike is least destructive of any of the present forms of fastenings in general use.

SPECIFICATIONS FOR CROSS- AND SWITCH-TIES: (*A*) WHEN USED WITHOUT PRESERVATIVE TREATMENT; (*B*) WHEN TO BE USED WITH A PRESERVATIVE LIQUID.

The committee was unable to secure definite instructions covering work on Subject No. 3 until September. These instructions directed the committee to take up specifications for ties which are to be subjected to preservative processes and suggested consultation with the committee on Wood Preservation. Believing it was then too late to secure action from the Wood Preservation committee as a whole, letters were sent to each member as follows:

"Sub-Committee No. 3, of the Tie committee of the American Railway Engineering Association, has been instructed to consider specifications for ties which are to be subjected to preservative processes.

"It has been suggested that ties, of a given species of timber, when intended for treatment, should have different qualities than if to be used untreated, and should therefore be purchased under different specifications. Kindly advise if your practice recognizes this difference or your experience proves its desirability.

"The sub-committee has been delayed in receiving its instructions, and as the time seems too short for action by the committee on Wood Preservation, as a whole, this letter is being sent to each member of the above committee, earnestly hoping that he will favor the sub-committee with an expression of his personal views at an early date."

After studying the replies it was concluded that the specifications for ties to be treated should be the same as for ties to be used untreated, except as to kinds of timber, length of time ties should be stored before delivery, and the amount of sapwood allowable in certain species.

A second letter was sent to members of the Wood Preservation committee, suggesting the following clauses to be inserted in specifications for ties to be treated:

"(1) Ties of the following species of timber shall not have been cut or trees felled more than.....months at the time of delivery: Red oak, pine, etc.

"This clause would be inserted only in localities where ties deteriorate very rapidly.

"(2) Ties made from cypress and dense pine, showing a greater amount of sapwood on the face than is permissible for ties to be used untreated, will be accepted and classed among the ties to be treated."

The replies received were mostly favorable to the insertion of these clauses.

The reason for specifying the maximum time that ties may be stored before delivery is to preclude the acceptance of ties that have been piled in such a manner and under such conditions that the fungi of decay have affected the ties without its being readily discernible.

The general clause in the specifications which rules out ties having any defect that affects their strength or durability could cover this condition, if it was apparent, but it is believed that the time limit is an important additional precaution. The time allowed after cutting should vary with the kind of timber and the local conditions of warmth and moisture. In some localities restrictions of this kind may not be necessary.

The committee submits the following for revision of the Manual:

Insert in Specifications for Cross-Ties at end of paragraph No. 2:

*"Ties made from white oak, cypress and dense pine, showing a greater amount of sapwood than is permissible for ties to be used untreated, will be classed among ties to be treated."

*To be inserted in localities where ties deteriorate very rapidly.

Insert at end of paragraph No. 3:

*"Ties of .....shall not
(Insert Species of Timber.)
have been cut or trees felled more than.....months at time of delivery."

*To be inserted in localities where ties deteriorate very rapidly.

Metal, Composite and Concrete Ties

The committee was instructed to report on trials of metal, composite and concrete cross-ties and to give results to date.

The information furnished by the various railroads using substitute ties was abstracted as usual, and the results to date were shown on the tabulated statement. This statement was intended to include all installations on steam railroads in America reported to the Association, and is thought to cover practically all substitute ties used so far in this country.

Recommendations for Next Year's Work

The committee recommends the following subjects for next year's work:

1. Methods in use by various railroads for controlling tie renewals.
2. Investigate the advisability of greater dimensions for cross-ties.
3. Make investigation of Forms M. W. 301, 302, 303 and 305, Statistics of Cross-Ties, to see if they are in general use on membership lines.

Committee: L. A. Downs (I. C.), chairman; F. R. Laying (B. & L. E.), vice-chairman; C. C. Albright (Purdue Univ.), M. S. Blaiklock (G. T.), W. J. Burton (M. P.), W. A. Clark (D. & I. R.), S. B. Clement (T. & N. O.), R. C. Falconer (Erie), L. C. Hartley (C. & E. I.), E. D. Jackson (B. & O.), E. R. Lewis (D. S. S. & A.), J. B. Meyers (B. & O.), A. J. Neafie (D. L. & W.), I. O. Walker (W. & A.), H. S. Wilgus (P. S. & N.), Louis Yager (N. P.).

Discussion

The President: Is there any discussion on the conclusions under "Effect of tie plates and fastenings in the life of cross-ties?"

A. C. Irwin (C. M. & St. P.): I would like to ask the committee what it considers as the normal increase in wheel loads upon which conclusion No. 4 is based?

F. R. Layng (B. & L. E.): The committee had in mind that there is a general movement towards heavier wheel loads, not only in engines but in cars, and we can expect this to continue somewhat in the future. These loads may not increase as fast in the future as they have in the past, but we feel that there will be an increase, and if this takes place the plates now considered satisfactory will not be strong enough.

Mr. Irwin: Does the committee wish to state any wheel load upon which they base the lack of strength of the tie plate? If the increase in wheel loads is of such magnitude as to make the present tie plates of insufficient strength, what is that load?

J. L. Campbell: I suggest that will depend primarily upon the strength of the tie and its ability to resist pressure and impact. I anticipate that the committee does not mean to say that one size of tie plates would be the size for all kinds of ties. It has been my observation that our tie plates are not large enough. They do not give sufficient bearing area. I believe it is the common experience of members of this association that wherever tie plates are being used, even the larger plates, there is some cutting into the tie, which, of course, will increase as the wheel loads increase. I believe that all five of the conclusions of the committee are wise and I approve them.

The President: If there is no further discussion, these conclusions will be accepted.

H. R. Safford (G. T.): I have nothing but good words to say about the report of this committee and particularly the information which they have collected and which appears in tabular form. The committee has not attempted to analyze these results in such a way that we could really get anything definite, and I presume the time has not been sufficient for them.

I would suggest to the committee that in their further analysis of these results, they give particular attention to trying to develop to a greater extent than has been done the information under question No. 4. If that information can be developed further along the lines of getting actual dimensions of plates that have failed, it would give the committee and the association much more reliable data to work upon.

W. M. Camp: I think this report is a good statement of the underlying principles of tie-plate design. I almost wish the committee had presented them as conclusions for insertion in the manual, because they seem to cover every case where tie plates do not meet the requirements. We now consider the chair type of construction on English railways as extreme, that is, the extreme use of metal. The English chair is essentially rigid and will not admit of any bending, and I think we will find that in order to meet the requirements of these increasing wheel loads, we must make some approach towards the English chair. I do not think that we can do any better than to take these five conclusions as a guide for future design of tie plates. I want to ask if it is the intention of the committee in their future work on tie plates to elaborate on these sections and conclusions?

Mr. Downs: Yes, we had hoped that this would be allowed to rest for a year or two, on account of the reconstruction period of track fastenings, and then we could

take the subject up again. That was our recommendation to the Board of Direction.

The President: If there is no objection, these conclusions will be accepted as information and printed in the manual.

Upon motion of Mr. Downs, the revisions of the manual under, "Specifications for Cross Ties" were adopted.

Mr. Downs: With reference to Subject 4, "Report on trials of metal, composite and concrete cross-ties, and give results to date," as this committee has stated on the floor many times, we are building up a history of these ties of which we are very proud. It will go down to the young man 100 years from now who will look up information as to how this substitute tie started.

The committee was excused with the thanks of the association.

Report on Uniform General Contract Forms

DURING the year the committee received several criticisms of the suggested form of agreement for industry track, submitted at the last convention. These criticisms have been given careful study by the committee and the form is re-submitted for the approval of the Association and publication in the Manual.

E. H. Lee, Chairman

Agreement for Industry Track

Preamble

This Agreement, made this..... day of..... in the year....., by and between .....party of the first part, hereinafter called the Shipper, and ..... party of the second part, hereinafter called the Company, Witnesseth:

That, Whereas, the Shipper for the more economical and convenient conduct of his business, desires the construction of an industry track substantially in accordance with the plans hereto attached and hereby made a part hereof, and the Company is willing that said track shall be so constructed, upon the terms and conditions hereinafter set forth:

Now, Therefore, in consideration of the covenants and agreements hereinafter mentioned to be performed by the parties hereto and of the payments hereinafter agreed to be made, it is mutually agreed as follows:

Right-of-Way

1. The Shipper shall provide at his own expense all necessary right-of-way, outside of the right-of-way of the Company, required for the proper construction of said track, said additional right-of-way to be satisfactory to the Chief Engineer of the Company. In case the lands of third parties are required, the Shipper shall secure good and sufficient titles or easements thereto and shall submit documentary evidence thereof satisfactory to the Company.

During the continuance of this agreement the Company shall have the right at all times to enter upon said lands for the purpose of constructing, maintaining and operating said track or any extension or addition thereto. If at any time this agreement is terminated as hereinafter provided, and the said track removed, the Company shall no longer have any right upon or interest in said additional right-of-way.

Permits, Ordinances, Consents, Etc.

2. If for the construction and operation of said track it be necessary to cross any public street, highway, or alley, or any public property whatsoever, and if the consent of any municipality, county, state, or of other lawful public body shall at any time be required for the construction or operation of said track, the Shipper shall at his own expense obtain and secure all necessary permits, consents, acts or ordinances of any nature whatsoever. In case any such body shall pass any rule, ordinance, order or other act which in any way affects said track, the Shipper shall furnish all facilities necessary on his part to secure compliance therewith, and shall pay all expenses incurred thereby.

Construction

3. The Shipper, at his own expense and subject to the approval of the Chief Engineer of the Company, shall furnish and do everything required to grade and prepare the roadbed for said track, including the construction of any culverts, drains, bridges, trestles, fences or other structures that may be necessary, except that by mutual agreement this work may be performed by the Company, in which case the Shipper shall reimburse the Company for the actual expense, including.....per cent on the cost of labor and.....per cent on the cost of material.

The Company shall furnish and do everything required to lay and complete the track above sub-grade, including the turnout switch, at the expense of the Shipper, except as follows:

.....

Advance Payment

4. Within.....(....) days after the execution of this agreement the Shipper shall deposit with the Company the sum of.....Dollars ($.....), being the estimated cost of the material to be furnished and the work to be performed by the Company in the construction of said track. Until said sum of.....Dollars shall have been so deposited, this agreement shall not become binding upon the Company.

Adjustment of Cost

5. If the actual cost exceeds the estimated cost, then upon receipt of a statement from the Company of the actual cost, the Shipper shall pay to the Company the difference between said actual cost and said estimated cost, and if said actual cost is less than said estimated cost, the Company shall refund the difference to the Shipper.

Rental

6. For the use of land, structures and material owned by the Company for said track, the Shipper shall pay to the Company an annual rental of.....Dollars ($.....), payable in equal quarterly installments, in advance.

Maintenance and Operation

7. The said track, together with switch lamps, signals and interlocking devices required in connection with its operation, shall be maintained by the Company at the expense of the Shipper. The operation of said switch

lamps, signals and interlocking devices shall be under the direction of the Company, at the expense of the Shipper.

Ownership

8. That part of said track located on the right-of-way of the Company shall be and forever remain the property of the Company.

Control

9. The Company shall have the right to enter upon said track for the purpose of construction, maintenance and operation, or if this agreement shall be terminated as hereinafter provided, for the purpose of removing the part of said track beyond its right-of-way.

Use and Extension

10. The Company shall have the right to use said track for general railroad purposes, and to extend said track, or to connect other tracks thereto, for the use of other shippers, providing such use, extension or connection does not unreasonably interfere with the business of the Shipper.

The Shipper shall not permit others to use said track, nor permit any other railroad company to connect its tracks thereto without the written consent of the Company, nor assign, transfer, lease or convey any of the rights, privileges or obligations of this agreement to any person or persons without the written consent of the Company.

Division of Rental

11. If the use of said track be granted to other shippers, or if said track be extended to serve other shippers, as provided in Section 10 hereof, the Company shall credit the Shipper an amount which is in the same proportion to the charges for rental, maintenance and operation as referred to in Sections 6 and 7, that the number of cars handled on said track for parties other than the Shipper bears to the total number of cars handled on said track during the period for which said total was computed.

Changes and Enlargement

12. If any rearrangement, extension or enlargement of said industry track or structures shall at any time be required by reason of any change in the Company's track, or tracks, or because of any changes in the operating practice of the Company, or for any other cause, or, if in the opinion of the Chief Engineer of the Company the introduction of signals or any other protective appliances shall be necessary in connection with said industry track, such parts of the work shall be done by the Shipper and the Company, respectively, as the Chief Engineer shall determine, and the cost, rental and charges for maintenance and operation shall be borne on the basis provided in the foregoing sections for the original construction, rental, maintenance and operation of said industry track.

If said change in the Company's track, or tracks, is of such a nature as to render advisable, in the opinion of the Chief Engineer of the Company, the temporary discontinuance of said industry track, the Shipper agrees that the Company may so discontinue said industry track, and hereby waives all claims therefor.

Freight Routing

13. In consideration of the benefits to be derived herefrom the Shipper agrees that so far as lies within his control, all freight shipped to or from said track shall be so routed as to travel the greatest practicable distance over the lines owned or controlled by the Company unless rates are lower or service better over another route, in which case the matter shall be brought to the attention of the Company, and if the Company shows that its rates or service are as advantageous to the Shipper as those of its competitors, then the business of the Shipper shall be routed as hereinbefore.

Freight Guaranteed

14. The Shipper further agrees to ship not less than .....carloads of freight annually from said track.

Liability and Indemnity

15. The Shipper hereby assumes all risk and responsibility for destruction of or damage to his property or that of the Company or of any person or persons, whether by fire or otherwise, or of death or injury to any person or persons, arising out of the construction, maintenance or operation of said industry track, and will defend and save harmless the Company from all claims, demands, payments, suits, actions, recoveries and judgments of every description brought or recovered against it arising out of the construction, maintenance or operation of said track, together with all costs and expenses connected therewith. The Company, however, reserves the right to join in the defense of any such suit or action.

Prevention of Accidents

16. The Shipper shall promulgate and enforce upon its agents and employes the necessary precautions and regulations for their conduct, guidance and protection, while engaged in and about his business, against injuries from engines, trains or cars moving or standing upon said industry track or the main or lead tracks of the Company. The Shipper shall take every precaution to prevent and avoid accidents of any nature whatsoever in connection with said track.

Clearances

17. The Shipper shall not erect nor permit to be erected any building or structure, nor permit any material to be placed above top of rail within..... (.....) feet of the nearest rail of said track on straight track, or within.....(.....) feet on curves; nor permit anything to be placed above said track lower than a height of.....(.....) feet above the top of rail, unless permission so to do is granted in writing by the Chief Engineer of the Company.

Obstructions and Inflammables

18. The Shipper shall at all times keep said track free from obstructions of any nature whatever, and shall guard against cars running from said track to the main track of the Company, and shall keep the said track and adjacent property free and clear of inflammable or combustible materials.

Load and Unload

19. The Shipper shall promptly load and unload his freight at his own expense and shall fully comply with the car service and demurrage rules of the Company.

Taxes

20. All taxes or assessments levied against said track by any municipality, county, state or other lawful authority shall be paid by the Shipper.

Forfeiture

21. If the Shipper shall at any time fail to perform any of the covenants herein contained, the Company may terminate this agreement by giving the Shipper..... .....days written notice thereof. If at the end of the said.....days time the Shipper still fails to perform his covenants to the satisfaction of the Company, this agreement shall become null and void, at the option of the Company.

If the number of loaded cars handled on said track for the Shipper is less than the number specified in Section .....and if in the opinion of.....of

the Company the amount of freight received from the Shipper is not sufficient to justify the continuance of this agreement, it may be terminated by the Company by giving the Shipper.....days written notice of its intention so to do. The fact that the Company has not terminated this agreement on previous occasions when it had the right so to do shall not be construed as a waiver of its rights to so terminate it and shall not prevent the termination of said agreement by the Company on any subsequent occasion as herein provided.

22. This agreement may be canceled at any time by either party hereto, by giving.....(.....) days written notice thereof to the other. Notice shall be deemed given to the Shipper if mailed to him at.....
(Address)
.....or if posted in a conspicuous place on.....premises. Notice shall be deemed given to the Company if mailed to its.....
.....at his office in.....

23. Upon termination of this agreement as herein provided, the Company may disconnect said industry track and may enter upon the premises of the Shipper and may remove therefrom anything which is owned by said Company, and the Shipper agrees to permit the Company to disconnect said track, and to remove its property, and to prevent any person or persons from hindering, molesting or interfering therewith.

24. This agreement shall inure to the benefit of and be binding upon the parties hereto, their heirs, executors, administrators, successors and assigns for a period of .....years from the date hereof and thereafter until canceled by either party giving to the other..... days written notice of its intention so to do, as hereinbefore provided.

In Witness Whereof, the parties hereto have executed this agreement in.....the day and year first above written.

Witness:

.....

Committee: E. H. Lee (C. & W. I.), Chairman; C. A. Wilson (Cons. Engr.), Vice-Chairman; C. Frank Allen, John P. Congdon (Cons. Engr.), Thos. Earle (Pa. Steel Co.), W. D. Faucette (S. A. L.), G. E. Gifford, Edward Gray (C. & O.), J. C. Irwin (B. & A.), R. G. Kenly (M. & St. L.), C. A. Paquette (C. C. C. & St. L.).

Discussion

E. H. Lee (chairman): Referring to the proposed form of agreement for industry track, this was submitted at the last annual meeting as information and referred back to the committee for further information, with the suggestion that during the year the members of the association who might be interested would offer such criticisms and suggestions as might occur to them, by letter. The reasons why the preparation of such a form was particularly difficult were set forth briefly in the report presented to the last meeting.

During the year, quite contrary to the plan of the committee, and as we were inclined to think without any special fault on our part, we were unable to have any meetings until this morning. This question was therefore necessarily handled through the exchange of letters.

We did have a meeting this morning and at that meeting a difference of view developed between the members of the committee. We feel that these differences are not fundamental, and that the committee itself can reconsider the matter and reconcile them. Therefore, in lieu of the conclusion presented in the report, I wish to offer the following:

"Your Committee on Uniform General Contract Forms recommends that the foregoing agreement form for industry track be accepted as information and again referred to the committee for further consideration."

The President: If there is no objection, this will be done.

(The committee was relieved with thanks.)

Report of Committee on Ballast

IT is generally conceded that stone is the most effective ballast, and experience has demonstrated that the best quality of each of the various kinds of ballast (using the definitions as found in the Manual) should fall in the following order of effectiveness: Stone, washed gravel, broken slag (not granulated), pit run gravel, chatts, burnt clay or gumbo and cinders.

The committee felt that in certain cases a physical test of the stone in gravel ballast should be made, and it therefore recommends that the physical tests for stone ballast now in the Manual should be used for gravel ballast, and the "center heading" in the Manual should read: "Physical tests of stone for gravel or crushed stone ballast."

H. E. Hale, Chairman

Certain members of the ballast committee have reported serious failures of ballast, both stone and bank gravel, due to weathering, and the committee has felt that a weathering test should be added to the physical test for stone, already approved by the Association.

In September 1915, 1,000 ft. of track near Guinea station, on the Richmond, Fredericksburg & Potomac, was ballasted on gravel, where less than 7 per cent of the gravel would pass through a ¼-in. screen. This test was made to determine whether the amount of sand recommended in the Manual for gravel ballast could be reduced. From September, 1915, to September, 1916, the cost of maintenance was $5 total.

The Richmond, Fredericksburg & Potomac, in 1910, considered it necessary to retain as binder in washed gravel ballast, 22 per cent to 25 per cent sand and small gravel (pass through a ¼-in. screen). In 1912 this percentage was reduced to 14 per cent and in 1915 and 1916 this percentage was reduced to 7 per cent average. The results obtained from 1915 and 1916 gravel are more satisfactory than those obtained from the gravel washed previously, and no difficulty has been experienced in keeping track to line. Results of this test indicate that the per cent of sand in gravel ballast, which was recommended in the Manual for Class "A" track, can be reduced to some extent.

This subject was assigned for investigation with special reference to the (a) organization of the most economical ballast gang of railway company forces, the (b) use and limitations of mechanical tools, such as the

pneumatic tamper and spreader for forming shoulder and path, and (c) application by contract.

The committee attaches a diagram of the N. Y. C. efficiency methods of raising track on stone ballast. This diagram illustrates the proposed arrangement of a force which is estimated to raise an average of 4,500 ft. per day.

The sub-committee drew up the following organization of a ballast gang, which in its opinion should be efficient and should complete 2,000 ft. of stone ballasting per day: One inspector or general foreman, 1 timekeeper, 3 foremen, 3 assistant foremen and 110 laborers.

They are to be used as follows:

For skeletonizing and putting in ties: One foreman, 1 assistant foreman, and 40 laborers.

For lifting and surfacing: One foreman, 1 assistant foreman, and 50 laborers.

For resurfacing, lining and trimming: One foreman, 1 assistant foreman, and 20 laborers.

Inspector to be in charge of distributing stone.

Total men, 118.

The discrepancy between the two gangs where 118 men complete 2,000 ft. of ballast per day and a force of 53 is estimated to raise 4,500 ft. per day is due to the different conditions.

The Delaware, Lackawanna & Western ballasted approximately 100 miles of double track on the Buffalo division, raising the track about 12 in. and averaging 6 in. raise for each "lift." Progress depended on local conditions, and to a large extent on train service.

The ballast gangs were organized as follows: One foreman, 1 timekeeper, 1 sub-foreman and 20 men skeletonizing the track; 1 sub-foreman and 10 men spacing the ties where new rail had been laid; 1 sub-foreman and 40 to 60 men ballasting, raising both sides at once, using 4 to 6 jacks; 1 sub-foreman and 30 men doing the final surfacing and dressing up the ballast.

In November, 1908, the Richmond, Fredericksburg & Potomac organized a ballast gang which was made up as follows: One general foreman, 1 timekeeper and commissary clerk, 1 assistant foreman and 20 men lifting the track, using old ballast as far as possible, but not tamping any ties which were to come out; 1 assistant foreman and 20 men regaging and renewing ties; 2 assistant foremen and 40 men applying the new ballast and surfacing the track, then dumping additional ballast for finishing and forming the shoulder; 1 assistant foreman and 30 men following about 3 days in the rear of the preceding gang to "catch up" any light settlement in surface, dress up and finish the track, ready to turn over to the regular section gang.

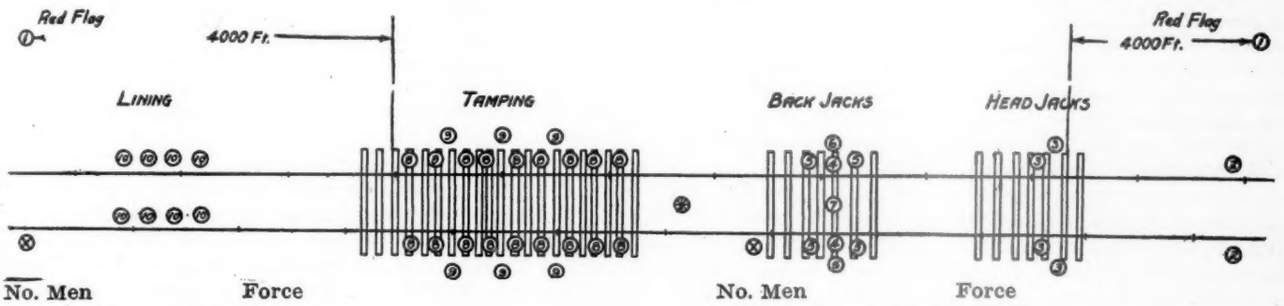
The cost of this work was 26.15 cents per cubic yard of gravel ballast applied.

In addition to the steam roads between 25 and 30 electric lines throughout the country are using mechanical tampers. As a comparison between last year and this year of the mechanical tampers in use, the following is of interest:

Name of Railroad.	Number in Use Last Year.	Number in Use This Year.
Boston Elevated	12	26
Delaware, Lackawanna & Western	4	128
Erie	2	50
Lehigh Valley	36	136
New York Central	76	269
N. Y., N. H. & H.	2	20
Pennsylvania	150	300
Pittsburgh & Lake Erie	2	12

One of the members of the committee took occasion on an annual track inspection to interview a number of roadmasters who have used mechanical tie tampers and to obtain their opinion of the device. Every one of the roadmasters who have used the pneumatic tie tampers to a considerable extent are enthusiastic in regard to them, and they consider the mechanical tamper as a coming necessary track appliance where stone ballast is used, both as a matter of economy and for obtaining better results. There does not seem to be any question now as to the superior results obtained from mechanical tamping. On main line sections formerly having an allowance of ten men, they are satisfied that the mechanical tampers will take the place of three men.

In the 1916, and in previous reports, the committee presented cuts of spreaders used for spreading ballast, with particular reference to spreaders designed to form the ballast shoulder and the path adjacent to the ballast. The committee has found that these ballast spreaders and shoulder formers are in use on many roads, and are generally considered a very necessary tool, and their economy is self-evident. The matter of designing the wing to form the shoulder and the path is a detail which should always be considered on account of the resultant economy.



No. Men	Force
2	No. 1—Flagmen.
2	No. 2—Digging Holes for Jacks.
4	No. 3—Head Jacks.
2	No. 4—Back Jacks.
4	No. 5—Tampers.
2	No. 6—Forkers and Sledge.
1	No. 7—Levelman.
18	No. 8—Tampers with Picks.
6	No. 9—Forkers.

No. Men	Force
8	No. 10—Lining Track.
1	No. 11—Water Carrier.
1	Star—Foreman Supervising the Work.
1	Cross—Assistant Foremen Raising Track.
1	Cross—Asistant Foreman Lining Track.
	Number of Men, 50.
	Total Force, 53.
	Average, 4,500 ft. per day.
	Average Back-Fill, 1,200 cu. yds. per day.

Standard Ballast Organization of the New York Central

Ballast Sections

Sub-Ballast means any material of a character superior to that in the adjacent cuts, which is spread on the finished sub-grade of the roadbed, and below the top ballast, to provide a better drainage, prevent upheaval by frost and better distribute the load over the roadbed.

Top-Ballast is any material of a superior character spread over a sub-ballast to support the track structure, distribute the load to the sub-ballast and provide good initial drainage.

It is realized that the depth of ballast is only one of three equally important factors in the problem of obtaining a uniform distribution of the trainload to the roadbed, the other two being the width of tie and the spacing of ties. An increase in the width of tie (within limits) or a decrease in the spread between centers would decrease the depth necessary to distribute the load. The tendency of late has been to help out the rail by decreasing the tie spacing.

The committee's previous recommendations have been based on an assumption of 2,640 ties to the mile or 24-in. spacing. The roads are now pretty generally using 18 ties to a 33-ft. rail, or 2,880 ties to the mile (22 in. center to center). Some roads are now using 3,040 ties to the mile, or 19 to a 33-ft. rail, a spacing of 20.84 in. center to center, and other roads are even contemplating the advisability of going to 20 ties to the rail or 3,200 to the mile, cutting the spacing to 19.8 in. center to center.

The matter then becomes one of economics, so far as ballast is concerned, whether to increase the number of ties or increase the depth of ballast, assuming that ties of the same size are used; and that in turn depends upon the relative cost of ballast in place to that of ties in place, making due allowance for the cost of maintenance of each and having due regard to the shortening of the span of the 800,000 "little bridges" formed by the rail, which would be produced by using an increased number of ties per mile.

Tie spacing has nothing to do with drainage and frost deformation. These matters are dependent upon depth, character of ballast and character of the roadway material. This makes a proper study of them relate closely to the work of the committee on Roadway.

The Altoona tests confirmed the fact, if confirmation was necessary, that clean stone, gravel, slag or cinders will provide complete drainage if the sub-grade and ditches provide a way for the water to run off after it has passed through the ballast, and that the depth required to secure proper drainage is much less than that required to properly distribute the load over the roadbed. Without proper drainage of the sub-grade the working of the ties pumps up the underlying "mud" and fouls the ballast.

This drainage can be secured more economically and more effectively by using longitudinal and cross tile pipe, laid open joint, with trenches filled with ballast material, and in very bad spots the pipe first covered all around with straw to keep it from clogging when first laid, then by increasing the depth of ballast. On account of the danger of displacement, bell-end tile should be used for both cross drains and the longitudinal drains.

The experience of the New England roads, where frost penetrates to a depth of 5 ft., has been that with 18 in. of clean ballast under the tie, *and a properly drained sub-grade,* trouble from distortion by frost action will be overcome. The under-drainage is much more effective than increasing the depth of ballast. To prevent "mud" working up into the ballast, a sub-ballast blanket of cinders 12 in. thick is very effective, much more so than an equal depth of rock or coarse gravel. Where the pipes in a cut clog in a short time or where a mattress of wood or concrete has been the only remedy, without going to an unwarranted depth, the thickness of the cinder blanket should be increased.

R. N. Begien, chief engineer of the Baltimore & Ohio, states that on the Magnolia Cut-off, recently constructed, the proposed ballast section had 24-in. ballast under the tie and a distance of 12 ft. from the center line to the outside edge of the sub-grade. On the Philadelphia, Baltimore & Washington, between Philadelphia and Washington, we are advised that at the present time there is an average of 24 in. of stone and 12 in. of gravel, measured from top of tie. There are points on this line where there is not quite this amount of stone and in places it is greatly exceeded. In the territory around Washington we find as high as 42 in. stone on top of 12 in. of gravel.

Conclusions

The conclusions reached by another year's study of the evidence at hand are in substantial accord with the previous recommendations of the committee and may be summarized as follows:

(*a*) The depth of ballast under the tie, on roadbed material such as clay loam, etc., subject to deformation by the application of live load, should not be less than the spacing, center to center, of ties. Before making more definite recommendations as to the absolute depth of ballast, or the proper ratio between depth of ballast and the spacing of the ties, the committee prefers to wait for the result of the Richmond test, which will be made with quartz gravel washed, and with the sand screened out, making it, in the opinion of this committee, for all practical purposes the equivalent of good crushed stone. On material which approximates the character of good sub-ballast (which will not be deformed by the application of the live load), the minimum depth of ballast under bottom of tie should be 12 in., to support the track structure; provide good initial drainage; provide against upheaval by frost action and serve as a cushion, and not for the purpose of uniformly distributing the load transmitted from the tie to the roadbed, which in such case would not be necessary.

(*b*) A sub-ballast blanket of cinders not less than 12 in. thick is effective in most cases in preventing mud and similar material working up into the top-ballast. Proper drainage of the sub-grade is essential to success with any kind of ballast.

(*c*) Until sufficient tests are made under normal traffic conditions, the question of the proper depth of ballast must rest on opinion based on experience and evidence, such as the test of Director Schubert of the German Railways and the "Altoona Test." The Richmond test will be valuable, but should be checked by other similar experiments with other kinds of material, and the committee again urges the importance of individual roads, or this Association, making the experiments necessary to check the result found by the proposed Richmond test.

(*d*) The committee renews its recommendation for a standard ballast section for Class "A" track with sub- and top-ballast, and a sub-grade width.

Committee: H. E. Hale (Pres. Conf. Comm. on Val.), chairman; J. M. Meade (A. T. & S. F.), vice-chairman; C. W. Baldridge (A. T. & S. F.), L. W. Baldwin (C. of Ga.), J. S. Bassett (M. P.), W. J. Bergen (N. Y. C. & St. L.), C. J. Coon (N. Y. C.), T. W. Fatherson (C. G. W.), Geo. H. Harris (M. C.), F. A. Jones (M. P.), S. A. Jordon (B. & O.), William McNab (G. T.), S. B. Rice (R. F. & P.), D. W. Thrower (I. C.), R. C. White (M. P.), H. L. Ripley (N. Y. N.

H. & H.), E. V. Smith (B. & O.), D. L. Sommerville (N. Y. C.), F. J. Stimson (P. L. W.).

Discussion

J. M. Meade, representing the chairman: The Ballast Committee have had the misfortune of losing two members by death, and also the misfortune of not having the regular chairman here. If you will indulge me I will read a little memorial that was prepared by our secretary on the death of Charles C. Hill. (Mr. Meade then read a memorial.)

Mr. Meade then read a portion of the report as follows: "It is generally conceded that stone ballast is the most effective ballast, and experience has demonstrated that the best quality of each of the various kinds of ballast (using the definitions as found in the manual) should fall in the following order of effectiveness (1) stone; (2) washed gravel; (3) broken slag (not granulated); (4) pit run gravel; (5) chatts; (6) burnt clay or gumbo; (7) cinders."

I move that that be adopted.

Mr. Ford: I don't think I agree with the committee on that classification and I don't think the experience of the members will agree with it. In a general way the committee is probably correct, but there are so many differences that would change that classification. I don't think it would be wise to make the hard and fast rule that it has. The committee says it should fall within the following classification, and then it designates the seven listed names. I would suggest the use of the words, "should fall in about the following order of effectiveness."

Mr. Arnold: I think it is the experience of the roads that use slag, that they ordinarily put that ahead of washed gravel ballast.

Mr. Meade: I will ask Mr. Price to reply to that.

S. B. Rice (R. F. & P.): There is as much difference in gravel as there is in stone. River gravel has a tendency to deteriorate and solidify under travel. If I had the preference between a mile of crushed stone and a mile of washed gravel of the character we have, I would take the gravel. It is easier to handle, and we can put it under track, and have put it under track at less than we can get crushed stone at the quarry.

J. A. Atwood (P. & L. E.): We have used crushed stone with gravel and slag, placed the crushed stone first, and gravel second and river gravel third.

J. L. Downs (I. C.): There is such a difference in washed gravel I think it should be divided, pit washed and river washed. When you say "washed gravel," there is the river gravel and the little particles are round, and if it is pit gravel, the little particles are angular. When you say "washed" it covers entirely different things. Therefore, I think it ought to be in two parts.

Mr. Camp: I would suggest another way to get around the difficulty. I don't believe the membership would agree as to the precedence of crushed gravel and broken slag. How would it be to say, "Washed gravel or broken slag?" Leave it to the discretion of the man using it.

Mr. Rice: The committee accepts the suggestion that the word about be inserted. We considered that quite carefully. The committee has received all sorts of suggestions, and has considered all the evidence that has come to it. I would rather deprecate the coupling together of 2 and 3. Doesn't the modification suggested cover sufficiently the case in point, if the word "about" or "generally" is inserted?

(The conclusion was adopted by the convention.)

Mr. Meade: The next is, "Weathering Test." That is fully covered by the printed matter. I will read the conclusions.

The President: That conclusion will be accepted as a report of progress.

Mr. Meade: "Your committee recommends a form of diagram of the organization of a ballast gang for study, and that this subject be referred back to the committee for further report."

The President: Unless there is objection the conclusion will be accepted as information and included in the proceedings.

Mr. Meade: I move the adoption of definitions of ballast sections.

(Motion seconded and definitions adopted.)

Mr. Meade: I move the adoption of the conclusions defining the proper depth of ballast.

J. R. W. Ambrose (Toronto Term. Ry.): I do not think that we should pass this conclusion, as it has a material bearing on the results to be found in the report of the Committee on Stresses in Track. Why should we make a conclusion now that would interfere with those conclusions?

Mr. Campbell: I believe the association would be safe in adopting the recommendations of the committee. Professor Talbot, in reporting for the Committee on Stresses in Track yesterday, while he was not able to give definite results, said as far as they had gone their conclusions confirmed the opinion of this committee. This merely says, "Depth of ballast should not be less than"—

I believe it is the common experience of the members, if they have only 12 in. of ballast under the tie, that it is not a sufficient depth. That does not mean that we have to increase the depth of the ballast. It is a recommendation of what should be the minimum depth.

Mr. Rice: This matter has been before the association some time. The Committee on Stresses in Track have made many experiments, and those experiments seem to demonstrate that the recommendations of the Ballast Committee are not far wrong. At the present time there is no guide before the association other than one which would seem to point to 12 in. as being sufficient depth of ballast. It would be folly to put in 24 in. ballast, if a 20-in. tie space is adopted. For instance the New England roads, and on the R. F. & P., where the sub-grade material itself is better than what the roads are using for ballast. It seems to me the question before the association is whether they shall present to the railroads and to the engineers who are and to those who are not members some standard to work to.

L. C. Fritch (Can. Nor.): I move that this recommendation of the committee be adopted. It is a move in the right direction. I think a recommendation of this kind ought to be made to secure a better foundation for our track.

Mr. Ford: I am in full sympathy with the committee in their endeavor to bring out something that will aid us. However, that does not carry with it the thought that we should rush into something that has not been considered fully. Will the committee consider this amendment, in the last line, in place of reading "should not be less," substitute the words "should seem to be not less than the spacing?" That carries the thought the member wants and will not commit the association to any clear-cut position.

(The recommendation, including Mr. Ford's suggestion, was adopted for insertion in the manual.)

Mr. Lindsay: Under the head, "Physical Tests of Stone," is that recommendation to be passed upon?

Mr. Meade: It is our intention to have that a recommendation only.

The President: Your intention is that this should be inserted in the manual, should be made to read, "Physical tests of stone gravel or crushed stone ballast?"

Mr. Meade: I make that motion.

Mr. Lindsay: If you change the physical testing of stone for gravel, under stone ballast, to physical test of stone for—or stone ballast, you will bring the whole clause under page 51 of the manual, that these tests shall be done by the Department of Agriculture, and it is a question whether we can test it by that method.

H. L. Ripley (N. Y. N. H. & H.): The point raised in the other discussion came up in the committee, that washed gravel was subject to the same variation in quality and physical characteristics as was the stone and the thought in the committee's mind was to have that apply more to a washed gravel, or something where money was spent to prepare the product, and washed gravel with the sand screened out of it becomes practically of the same character as the stone, and it was the intent of the committee to recommend to the association that it be subject to the same test, and it is just as necessary, if you are developing a gravel plant with a million yards in it, to subject the product of that pit to the same test that you would subject the product of the quarry to before you decide to install the plant at that point.

Mr. Lindsay: I have no question of the necessity of testing the gravel.

The President: Have you any suggestion to make?

Mr. Lindsay: In the absence of the requirements of the United States Government, I have nothing to offer at this time.

Mr. Meade: The committee will reconsider this question. I move that section (a) on sub-ballast be adopted.

Mr. Ford: I would like to ask the committee if they will consider the elimination of the words "not less than 12 in. thick" and the addition of the word "substantial," so that the clause shall read, "A substantial sub-ballast blanket of cinders not less than 12 in. thick is effective in most cases." I have been experimenting with a layer of cinders on top of roadbed ballast. I know that the blanket is a very desirable thing, but I am not so sure about the depth. I think the committee will cover this if they will eliminate the depth in that section.

Mr. Meade: I don't think anything less than that, on account of the cheapness of ballast, would be safe to recommend.

Mr. Ford: I have to take issue with the committee on that. I move the elimination of "not less than 12 in. thick" from that recommendation. (Motion seconded.)

(The amendment was lost.)

The President: Now the original motion is on the adoption as given.

(Recommendation adopted.)

Mr. Meade: Now I move that sections (c) and (d) be adopted.

J. L. Campbell (E. P. & S. W.): I have no objection to this section, except in minor parts. It would be practicable, at more or less expense, to dress the sub-grade as shown. I do not believe that the proper section could be maintained in the form shown, and merely as a matter of practicability I would like to see the association go back to the sub-grade ballast with a straight line under the ties. I believe it is the practical way of preparing the sub-grade, even though the section will not remain. The ballast almost inevitably becomes deeper in the center of the roadbed and works out from the edges. It will be only a question of time, if we dress up the sub-grade as shown, until we will lose that section, and I do not see any advantage in spending a dollar in securing the particular form shown.

(The motion was put to vote and carried.)

The President: We will now take up the consideration of Class "A" sections—Crushed stone and slag, for single track on tangent.

J. R. W. Ambrose (Tor. Term. Ry.): I would call attention to the fact that this ballast section requires a roadway 26 ft. wide for single track. How many engineers are there who will recommend a 26-ft. roadway for single track?

H. L. Ripley (N. Y. N. H. & H.): Referring to Mr. Lindsay's statement and the statement contained in the manual, that leaves us with a standard section to apply to a roadbed firm and offering a first-class support to our track. This recommendation of the committee also calls for 12 in. of ballast under the tie under similar conditions. We recognize further, however, that on a roadbed which has not good sustaining power that an additional depth of ballast be provided. It recommends that ballast generally be of a character less expensive than crushed stone or the high-class top ballast. I think the two are not in conflict.

J. G. Sullivan: In view of the motion which just carried, would it not be necessary to change the figures on these drawings?

Mr. Meade: I do not think so, from the thicknesses given there.

Mr. Sullivan: I notice that 12 in. is given as the depth of the sub-ballast. I understood that the depth of the sub-ballast was left out of the specification.

Mr. Meade: I think not.

R. H. Ford (C. R. I. & P.): I do not want the committee to feel that I am objecting to its work, but I feel that the question of ballast depth is of very great importance. As I understand the committee, it is anxious at this time to get the association to commit itself definitely to this regular standard ballast section, and I think it would be very unfortunate for this association to go on record and determine what shall be a standard ballast section. That cannot, in my judgment, ever be adopted. I think the committee can lay down principles for the guidance of the railroads as to what they shall conform to in the construction of their roadbeds and the application of ballast, but beyond that I do not think they should go. Laying down good practice is all right, but coming to a definite conclusion that this or that shall be the standard, and if the roadbed does not conform to that it is not up to standard, is bound to cause more or less confusion in the end, and the recommendation of the committee, in my opinion, will not be adopted in detail by the roads.

The President: Is there any further discussion in regard to this first proposed section of class A single-track on tangent? If not, all those in favor of adopting this for the manual will signify by saying aye; opposed, no. The noes have it, and the section is not adopted.

These four sections are so interdependent that a motion to refer the first back to the committee would necessarily carry with it the other three. If there is no objection that will be done.

The Committee on Ballast is excused with the thanks of the association.

Report of Committee on Yards and Terminals

THE committee's report for 1915 referred briefly to double-deck freight houses, the use of which will tend to increase the working area and economic capacity of the freight-house site. There are as yet but a limited number of freight houses of this class, and few of these have been designed for the purpose of increasing the capacity of a given site. They have been built generally to meet topographical conditions, mainly artificial topographical conditions consequent upon the separation of grades of streets and tracks. In these installations the teams are on one floor (at the street level) and the tracks on the other floor.

In very few cases is there a real double-deck arrangement, that is, with each deck having tracks and team driveways so as to form a self-contained or independent unit. It seems evident that this last case is the one which will increase the economical utilization of the site. A further development is the use of upper floors for warehouse purposes, above the freight house proper. This will tend to still further increase the capacity.

E. B. Temple, Chairman

The following list of existing double-deck freight stations is presented:

Chicago Great Western	Minneapolis
Missouri, Kansas & Texas	St. Louis
Minn., St. P. & S. S. M.	Chicago
Pennsylvania Lines (New)	Chicago
Pennsylvania Lines (P. Ft. W. & C.)	Pittsburgh
Pennsylvania Lines (P. C. C. & St. L.)	Pittsburgh
Wabash	Pittsburgh
Pennsylvania	Philadelphia
Central of New Jersey	Newark
Long Island	Brooklyn
Southern	Atlanta

The committee in its report of 1915 pointed out two points in regard to the use of motor trucks for handling freight at freight houses. In the first place there is a growing opinion in favor of the use of such trucks for this purpose. In the second place there is a growing opinion that their greatest service is in acting as tractors to haul trailers, rather than in acting as trucks to carry loads.

The field of action for such motor trucks includes express stations and transfer stations. The tractor-trailer system (with three tractors) is in use at the freight house of the Chicago Junction Railway at Forty-third and Robey streets, Chicago, and appended to this report is an abstract of a report by W. J. O'Brien, General Superintendent. (Appendix B.)

The same system is in use for handling express matter. Wells Fargo & Co. employ two tractors in this service at the Kansas City Union Station, and the American Express Company will employ two tractors at its west side terminal in New York. In these three cases the tractors are three-wheel one-ton storage battery machines of the Mercury type. The trucks or trailers are connected by special chain couplings which cause the trucks to track or follow exactly the same path, even when turning sharp curves or corners. Some of the trailers are of special design, being two-wheel units, which can be coupled to form four-wheel trucks.

Track-Scale Specifications

The sub-committee on this subject has held several joint meetings with the sub-committee on Standards of the committee on Weighing, of the American Railway Association, and the report herewith presented is the same in all material respects as will be recommended by the sub-committee on Standards of the committee on Weighing for adoption by the American Railway Association.

The following recommendations are made with the view of setting an ultimate standard to which railroads generally may work, but are not intended to condemn scales, methods of installation or reinstallations, etc., now in service, which come within the sensibility and tolerance prescribed in Section 2 and respond to tests as prescribed in Section 10:

1. *General.*

The selection of a track scale should be based on the following principal considerations:

(a) Maximum loads to be moved over the scale for weighing or otherwise, the spacing of the supporting axles and the concentration of weight thereon.

(b) Length of wheel base of cars or other equipment to be weighed.

(c) Whether loads are to be weighed stationary or in motion.

2. *Scale Design.*

(a) Scales should be so designed that when the load is applied to the main supporting levers, the oscillation of the platform will not displace the bearings as points of contact on the knife-edges.

(b) The vital parts should be readily accessible for cleaning, inspection and adjustment.

(c) Like parts of a scale of given manufacture, type, length and capacity should be interchangeable as far as practicable.

Note.—Some roads specify that scales of the same type, length and manufacture be interchangeable on foundations, while other roads specify further that scales of the same type and length but of different manufacture be so interchangeable.

(d) Scales should be constructed preferably in not more than four sections.

(e) In scales of more than two sections, either of two methods of designing weigh-bridge girders may be employed: (1) Girders of continuous type; (2) non-continuous girders of such design of bracing and of joints over the center of bearings as will admit of flexure vertically without derangement of sections.

(f) Practical means of adjustment, such as wedges, etc., should be provided to secure proper distribution of the load on the scale at the points of support.

(g) To insure parallelism of pivots, machined ways should be provided where nose irons engage the levers. The nose irons should be designed for movement by a non-corrosive machine screw or other mechanical device, and, in addition to this, each nose iron should be clamped in position by at least two binding screws or bolts, or an equivalent locking device. The use of set screws which make indentations in the levers is undesirable, on account of such indentations making it difficult to secure nose-irons in exact position when slight adjustments are made. The normal position of nose-iron as determined by shop sealing should be marked by a line or some equally effective method.

(h) Levers should be provided with leveling lugs, upon which a level can be placed to establish the horizontal position of the levers. The faces of these lugs should be machined in line with the contact edges of the two end pivots or knife-edges. They should be as far apart as practicable and not closer together than 10 in.

(i) When the scale design requires the use of checks, either the rod or the bumper type may be used. They should be located as nearly as practicable at the top plane of the weigh-bridge girders and check-rods horizontal when the average load is on the scale. Check-rods should be adjustable and set without initial strain.

(j) Beams should be so designed as to weigh all loads on main and fractional bars without use of hanger weights. The main bar of beam should have not more than 6 notches to the inch, each notch to represent 1,000 lb. The fractional bar should be graduated to 50-lb. subdivisions, with not more than four subdivisions to the inch.

A shoulder should be provided on all beams to prevent the poise traveling back of the zero graduation. Where the scale is not equipped with a full capacity beam, the maximum capacity must be clearly and permanently placed on the scale, where it may be seen easily. To facilitate accurate reading of the scale beam, symmetrically indicating poises are desirable.

Beams should be fitted with a pointer, to be used in connection with a fixed pointer to indicate a central position in the trig-loop when the beam is horizontal. In order to prevent magnetization which impairs the vibratory action of the beam, the trig-loop should be of brass or other non-magnetic material.

(k) The beam should be supported directly by a one-piece beam stand securely attached to a metal shelf supported by metal columns. Means should be provided for adjustment to maintain the vertical alignment of the steelyard-rod. The columns and shelf should be preferably of cast iron. The beam-rod and steelyard-rod should be provided with pin-and-clevice connections instead of hook connections. The steelyard-rod should be adjustable as to length by turnbuckles secured by lock nuts at both ends. The lock nuts should be additionally secured by binding screws.

(l) Multiplication at the butt of the beam should not exceed 800 to 1. In order to secure uniformity the following multiplications for levers of four-section scales of the straight lever type are suggested:

Main levers	4
Extension levers	10
Transverse extension lever	5
Shelf lever	4

(m) A recording beam should be used where spot weighing is performed.

(n) The sensibility reciprocal is the weight required to move the beam a definite amount from the pointer or other indicating device of a scale. In scales provided with a beam and trig-loop the sensibility reciprocal is the added weight required to be placed upon the platform to break and turn the beam from a horizontal position of equilibrium in the middle of the trig-loop to a position of equilibrium at the top of the trig-loop. This may be determined by subtracting the weight instead of adding it, or by using the sliding poise on the beam, if this is done without jarring the beam.

For railroad track scales the angular movement or play should be 2 per cent of the distance between the trig-loop and the fulcrum knife-edge, and the sensibility should correspond to 50 per cent of the angular movement of the beam.

The sensibility reciprocal of a track scale should never be more than 100 lb., and when the scale is new should be not more than 50 lb. For verification purposes, when new, a scale should be capable of adjustment to within 1/2000 (one-half lb. to the thousand lb.) of the test load used.

Track scales should be kept in the closest possible adjustment, and a scale should be considered inaccurate when it cannot be adjusted and such adjustment maintained to within 2 lb. to 1,000 lb., in excess or deficiency, when distributed test is made with two or more test loads. When only concentrated sectional tests are made, the maximum error in any section should not exceed 3 lb. to each 1,000 lb. of test load used.

(o) Knife-edges, pivots and bearing-steels should be properly fitted, and so mounted, reinforced and designed in relation to flexure that uniform contact and pressure will be secured under all conditions of loading. Bearings should be self-aligning wherever practicable. Knife-edges should be fitted in machined ways. Pivots and bearing-steels should be so fitted, when necessary to comply with the requirements of this paragraph.

(p) Anti-friction contacts should be used where necessary to limit the longitudinal displacement between knife-edges or pivots and bearings, and the angle formed at the contact faces of knife-edges and pivots should be symmetrical on a vertical line through the center of the section. They should be smooth, at least as hard as the parts with which they come in contact, and so designed as to provide contact at a point on the line of the pivot edge.

To reduce friction between loops and levers, the friction faces of all loops should be flat, instead of cone-shaped, and the lever equipped with one-point contacts in line with the pivot edge.

3. *Capacity.*

(a) The capacity of a scale should be determined by the weight of the heaviest car to be weighed upon it, and for purposes of design a scale should support a train of such cars passing over it, plus the dead load, without stresses being developed in the members of the scale which are in excess of those specified in Section (b).

However, in order to secure a measure of uniformity and avoid a multiplicity of designs, due to different assumptions of loading, the following load factors based on cars in a train or coupled together may be used for four-section scales from 50 to 65 ft. in length. The load factor is the percentage of the capacity of the scale, which, when modified by the multiplication factor, gives the load applied to the respective scale members:

Main lever	30 per cent
End extension lever	50 per cent
Intermediate extension lever	100 per cent
Transverse extension lever	200 per cent
Shelf lever	200 per cent
Poise beam	175 per cent

(b) Working unit stresses per square inch are as follows:

Nature of Stress	Gray Iron Castings.	Steel Castings.	Wrought Iron.	Structural Steel.	Steel for Knife-Edges and Bearings
Tension	1,500 lb.	8,000 lb.	8,000 lb.	10,000 lb.	24,000 lb.
Compression	8,000 lb.	10,000 lb.	8,000 lb.	10,000 lb.	24,000 lb.
Transverse Bending—					
Tension	2,500 lb.	8,000 lb.	8,000 lb.	10,000 lb.	24,000 lb.
Compression	8,000 lb.	10,000 lb.	8,000 lb.	10,000 lb.	24,000 lb.
Shear	2,500 lb.	6,000 lb.	5,000 lb.	7,000 lb.	.....
Torsion	2,500 lb.	6,000 lb.	.....	7,000 lb.	.....

Bearing stress per square inch on steel pins, 15,000 lb.

Unit stress per square inch in cross bending on steel pins 15,000 lb., assuming the center of bearing of strained members as the point of application of load.

NOTE.—It may be permissible to modify the assumption, as above, where the unit-bearing pressure is less than that specified, or where the pins have a driving fit. In these cases the moment arm may be reduced by assuming the points of application of the load a sufficient distance from the face of the member to make the bearing stresses equal to 15,000 lb. per square inch.

Bearing per linear inch of knife-edge not to exceed....7,000 lb.
Bearing on concrete, per square inch ..... 400 lb.

Maximum deflection at any point of the lever, resulting from the load applied at the intermediate pivot with the lever supported at the end pivots as a simple beam and measured from a straight line joining the end pivots, should not exceed 0.06 in.

(c) In the design of loops and links the unit stresses should not exceed those specified in Section (b), considering the section of the link at the point of maximum bending moment to be determined by the formula $\frac{WL}{4}$ where "W" equals the maximum concentrated load to apply to the link or loop, and "L" equals the distance between the center lines of the depending sides.

(d) Where practicable, knife-edges and pivots should be supported their full length by integral parts of the levers. The supports should be of such design as to carry the total load applied to the knife-edges or pivots without exceeding the unit stresses in Section (b).

Where impracticable to so support the pivots the bending moments should be determined as follows:

Let W = Total load on both ends of pivot.
L = Lever arm required.
S = Bearing surface in loop.
T = Distance between friction faces of loop.
B = Width of boss or sustaining member of enveloping pivot.
M = Bending moment in pivot.

Then $L = \frac{S}{2} + (T - B) + \frac{1}{4}''$.

And $M = \frac{WL}{2} = \frac{W}{2}\left[\frac{S}{2} + (T - B) + \frac{1}{4}''\right]$.

High carbon steel may be used for knife-edges, pivots and bearings, but for enduring wear under heavy weighing service special alloy steel possessing the following physical properties, with the internal strains relieved by drawing after hardening, is recommended:

Ultimate tensile strength	200,000 lb. per sq. in.
Elastic limit	165,000 lb. per sq. in.
Elongation in 2 inches	5 per cent
Reduction in area	25 per cent
Unit stress in transverse bending	24,000 lb. per sq. in.

(e) Structural steel used for weigh-bridge girders and for the cross-girders supporting the dead rail should conform to the specifications for steel structures as adopted by the American Railway Engineering Association, except as provided in section (b). In order to avoid distortion, each pair of weigh-bridge girders should be fabricated complete with sway and lateral bracing in the shop under proper inspection; where this method is impracticable and field assembly is necessary, each pair of

girders should be placed in proper alinement and the bracing then introduced and secured by bolts or rivets.

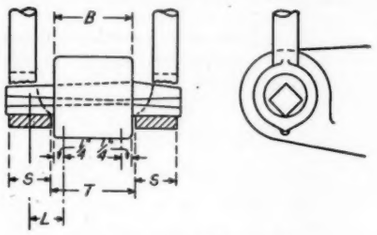
(f) Bids for scales should be accompanied by detailed specifications and by plans showing general arrangements. After the order is placed, the manufacturer will also, when requested, furnish stress sheets and plans showing the dimensions of levers and of the various parts of the scale sufficiently in detail for making a satisfactory check.

4. *Length.*

(a) The length of scales should be considered as the distance between the ends of the scale rail.

(b) The ends of the scale rails should not project beyond the knife-edges of the end main levers.

(c) When cars are to be weighed spotted, the scale rail should be of sufficient length to permit the entire car to be



Support for Knife-edges

placed on the scale, and preferably longer to facilitate spotting. A length of not less than 50 ft. is recommended.

(d) When cars are to be weighed in motion, the speed should not exceed 4 miles per hour and each car should be entirely and alone on the scale a minimum time of 3 seconds. The length of scale should be such that these conditions will obtain for cars normally weighed. When scales are of such design or length as not to permit the above speed, cars should be passed over the scale at a slower speed or be spotted if necessary to secure accurate weights.

5. *Location.*

The proper location of scales depends principally on the following conditions: (a) The volume of traffic to be weighed in comparison with that switched over the scales and not to be weighed. (b) Whether scales are to be equipped with dead rail or relieving gear. (c) Whether a run-around track will be installed for switching with a separate track for weighing. (d) Whether cars are to be weighed spotted or in motion. (e) The cost of extra switching, when scales are not located on lead to classification track. (f) The cost of maintenance when the scale is located on the lead to the classification tracks and only a small proportion of the cars are to be weighed. (g) The necessity for quick dispatch of cars that are weighed.

NOTE:—So much depends on local conditions affecting the different carriers that it would be difficult to give exact rules in connection with the above suggestions. It is recommended, however, that there be not less than 50 ft. of tangent track at each end of the scale rails. When only a small proportion of cars handled are to be weighed, the rails leaving the scale in the direction of weighing may be curved and the dead rail straight, or the curvature may be equalized between them.

6. *Grade.*

(a) When scales are located on a lead to classification tracks in hump yards they shall be at sufficient elevation that cars will run by gravity as far as desired into the classification yard, considering a maximum speed of four miles per hour over the scales.

(b) The distance and grade from the apex of the hump to the scale should be such that the speed of free-running cars with varying lengths of wheel base will be automatically controlled without brake application, so that a speed of 4 miles per hour will not be exceeded while passing over the scale, and cars should be so spaced that the weighing period of 3 seconds will not be reduced.

(c) Scales to be used for motion weighing should be constructed with the scale rails on a gradient not greater than 1 per cent. The weighing mechanism must in all cases be installed on a level plane, with supports introduced to fix the weighing rails on the desired gradient.

(d) Where it is the practice for one car rider to take several cars together into the clasification track, the same grade as on the scale should be maintained for at least 100 and preferably 200 ft. beyond the scale in the direction of weighing, so that cars may be stopped easily by car riders and that succeeding cars will not cause excessive impact when striking the car ahead, which should occur not less than one car length from scale.

(e) When scales are installed not in connection with humps, they should be at a sufficient elevation for protection against surface water. In order to prevent impact on the scales and facilitate weighing, it is also necessary that there be sufficient elevation to permit cars to run away from scale by gravity after being weighed.

7. *Pit and Foundation*

(a) The scale pit should be constructed of Portland cement, concrete or of cut stone masonry laid with Portland cement mortar. It should be designed and constructed with especial care to prevent settlement.

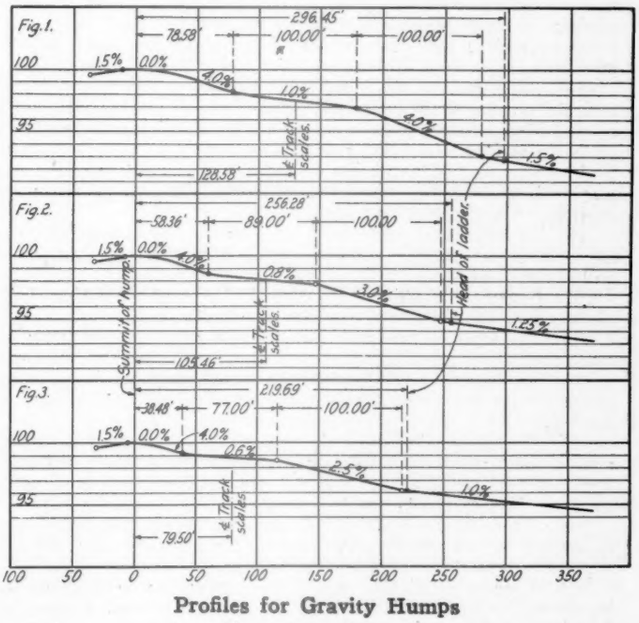
(b) The bearing areas of the footings of the different parts of the pit on the foundation should be such that the bearing pressure per square foot on the soil will be uniform throughout and not exceed:

For find sand or clay	4,000 lb. per sq. ft.
For coarse sand and gravel or hard clay	6,000 lb. per sq. ft.
For large boulders or solid rock	20,000 lb. per sq. ft.

If the soil has not a safe bearing capacity equal to that of fine sand or clay, its bearing capacity should be increased by drainage, by adding a layer of gravel or broken stone or by driving piles.

(c) Concrete should be composed of one part of Portland cement to not more than three parts of sand and not more than six parts of pebbles or crushed stone. The qualities of the materials and the method of mixing and placing the concrete should be in accordance with the railroad company's specifications for first-class concrete.

(d) The tops of piers and of parts supporting stands or other metal parts should be above the floor of the pit a distance sufficient to prevent the accumulation of water under the bearings. The tops of piers and walls supporting parts of the scale or superstructure should be finished level and at the correct elevation without the use of shims or grouting. The finishing of the scale stand bearings to exact level and elevation is



Profiles for Gravity Humps

especially important. The floor of the pit should slope uniformly to the drainage outlet and should not be less than six inches thick.

(e) Where necessary to prevent seepage of water through foundations into the scale pit, they should be waterproofed and drained into a waterproofed cistern located outside of the scale pit and equipped with either hand pump, air siphon or steam siphon.

(f) Drainage should be provided in all cases where there is a possibility of water getting into the pit and where excessive seepage is not present and there is sufficient fall, pipe drainage should be used.

(g) A minimum period of ten days should elapse between the placing of the last concrete and the putting of the scale in service to permit the proper setting of the concrete. The proper setting will be influenced by the prevailing temperature

and weather conditions during that period, and this should be given due consideration.

(h) The masonry should extend at least 15 ft., and preferably 25 ft., from the pit face of the end wall at the approach end back under the track, to preserve the line and surface of the approach tracks, which is difficult when ballast is used. The longer approach walls are desirable on account of the ballast beyond them giving way, thereby making it difficult to keep the approach rail properly anchored at the scale end.

(i) The foundation pit should be of ample size to allow freedom in making inspection and repairs, and access to it should be from the side if practicable; otherwise, by means of stairway or fixed ladder from scale house. The length of the pit inside of the end walls should be not less than 2 ft. greater than the length of the scale parts.

8. *Installation*

(a) Scales should be installed with a dead rail or relieving apparatus.

(b) The deck or platform should be of the fixed type, so that the balance of the beam will be least affected by weather conditions, etc. It should be made as nearly dirt and water proof as possible.

(c) Scales to be used for spot-weighing should be constructed with the scale rails level, and, where cars are weighed coupled together at one end, rails approaching in the direction of weighing should be in the same plane with the scale rails for a distance of at least 50 ft.

(d) Wedge or other means of adjustment used between the bridge and scale supports to assure proper distribution of loading should be set as low as possible when the scales are installed, as future lining usually requires raising a bridge rather than lowering it.

(e) The scale should be set directly on foundations or on metal bed-plates resting on foundations. The surfaces of castings which bear on masonry, on steel members, or on each other should be machined.

(f) Scale parts, where necessary, should be securely anchored to foundations, and it is desirable that means of slight adjustment, longitudinally and transversely, be provided for properly setting the scale, interchanging scales in the same pit, etc., in order to secure perfect freedom of action for all parts in suspension.

(g) Supports for the scale beam and shelf lever should rest directly on the scale foundation, and suitable clearance should be provided between the inside of the scale-office and the beam supports and shelf. (See rule 2 (k)).

(h) The use of extension levers between the transverse extension lever and the scale beam is undesirable, except when the shelf lever is used for an extension.

(i) To prevent interference, proper clearance between the movable parts and the adjacent fixed parts should be provided and maintained.

(j) One-piece scale rails are desirable, and they should be of adequate section for supporting the load.

(k) An efficient transfer rail, or other connection, may be used to prevent the impact of cars moving over the joint between the approach and scale rails, such contrivance to be so designed and maintained as not to interfere with the action of the scale.

(l) The approach and scale rails should be anchored to prevent creeping and should be maintained in proper line and surface. Where anti-creepers will not prevent the creeping of rails, switch points should be used.

(m) Scale pits should be heated wherever practicable and necessary to prevent freezing and to keep the pit dry, thereby preventing rust.

(n) Proper ventilation will be of assistance in keeping the levers of the scale and the scale pit dry. However, it may not be advantageous under conditions where the outside air entering the pit contains more moisture than the air in the pit, or is warm and cooled below the dew point when it enters the relatively cooler pit, thereby causing condensation or cold sweating of the scale parts. The method of ventilation, therefore, should be such that these conditions may be controlled, as far as practicable.

(o) Scale pits should be properly lighted for purposes of cleaning, inspection and testing.

(p) Scale houses should be constructed at track scales for the proper housing and protection of the scale beam and the protection of the weighmaster.

(q) The interior and exterior of the scale houses should be amply and properly lighted to afford proper facilities for weighing and the prevention of mistakes in reading the scale beam, car numbers and stenciled light weights. This applies more especially where cars are weighed at night.

9. *Maintenance and Operation*

(a) All track scales should be numbered and referred to by number and location.

(b) Extensive repairs to scales, such as the renewal of or sharpening of pivots, should be made in a properly appointed shop.

(c) When scales are in service regularly, scale parts, substructure and foundations should be cleaned at least twice a month, and when exposed to the elements, or otherwise so located that they are liable to become clogged with ice or dirt, they should be cleaned oftener, if necessary.

(d) The application of rust preventives to bearings is desirable, but they should be so applied as not to interfere with the proper working of scale.

(e) If ice obstructs the levers, salt should not be used to melt it; artificial heat should be used wherever practicable.

(f) Equipment should not be allowed to stand on the scales, except when being weighed.

(g) Engines or other equipment not to be weighed should not be passed over the scale rail except on authority of the department having supervision over the installation and maintenance of scales.

(h) Cars should not be bumped off scales by the engine or another car on the dead rail, nor be pulled across the scale coupled to another car moving over the dead rail.

(i) Enginemen should not apply sand to the scale or dead rail, nor should the injector in an engine be applied when the engine is standing on or passing over the scale. The slipping of engine drivers on either the scale or dead rail is injurious to the structure, and should be avoided whenever possible.

(j) The weighing beam should be balanced before the scale is used and when not in use should be locked with the beam catch.

(k) Cars should not be stopped violently on the scale by impact, by the sudden application of brakes or by throwing obstructions under the wheels. When pushing cars off the scale which have been stopped for weighing or otherwise, impact must not occur at a speed greater than two miles per hour. When necessary for any reason to run cars over scale rails, the speed must not exceed 4 miles per hour.

(l) The weighmaster should familiarize himself with the construction of the scale and make such inspections at such intervals as are necessary to determine if the scale is in proper working condition.

(m) Persons appointed to inspect and clean scales should be properly instructed, and it is desirable that they be present with the scale inspector when scales are tested.

(n) Scales and structural steel should be cleaned and painted with one coat of red lead paint before installation, one coat after installation, and at such other times as may be necessary.

10. *Testing*

(a) The standards of mass for testing scales should be derived from primary weights, verified by the U. S. Bureau of Standards, Washington, D. C., to within what is known as their "Class B tolerance." Such weights can be obtained either direct or through scale manufacturers. The 50-lb. secondary or working cast-iron weights, which are transported from place to place and used directly in testing scales, should be rectangular and of such design as to facilitate stacking; they should be free from pockets, blow holes, etc., which are liable to catch and hold foreign matter. No adjusting cavity or cavities in the bottom of the weights should be permitted.

These weights should be properly painted, surfaces maintained in good condition, and be tested and adjusted in comparison with the master-weight, which has been verified to within "Class C tolerance" (U. S. Bureau of Standards). The working weights shall be adjusted to within 25 grains and maintained to within 100 grains of their true values. NOTE:—The standards for testing scales in the Republic of Mexico must be in accordance with the metric system standards and will be verified by a federal scale inspector in accordance with the federal laws.

(b) Track scales in regular car weighing service should be tested at least every three months with test car or test weights weighing not less than 30,000 lb.

(c) Scales when installed and periodically thereafter should be given a graduated test with two or more test loads up to the weight of the heaviest cars normally weighed. The necessity for the frequency of such a test depends on the design, capacity and method of installation of the scale used, the wear of scale pivots, and the amount of weighing performed.

(d) Where frequent tests cannot be made in accordance with paragraph (c) a test should be made each week by weighing a heavily loaded freight car with as short a wheel base as is obtainable, on each end and the center of the scales. When the scale is equipped with an automatic weighing attachment, the

car should, in addition to the above, be weighed, spotted on the trip end of scale and in motion with the automatic attachment connected. A report of these tests should be sent to the officer in charge of scales and weighing.

(e) In addition to the above a daily test should also be made on each scale equipped with an automatic attachment, by weighing a car spotted on the trip end of the scale with the beam, also in motion with the automatic attachment connected. A book record of this and other tests is to be kept by weighmaster.

11. *Automatic Weighing and Recording Devices*

Efficient automatic weighing and recording devices may be used where desired. There has been in the past, however, and may be at present, an impression by some that the automatic weigher and recorder will overcome all outside influence and give correct results regardless of scale and track conditions and the speed at which cars are handled over the scale. This is an erroneous impression, as it is absolutely necessary that the scale and the automatic device as well be in first-class condition with properly maintained approach tracks and cars must be run at a low rate of speed with particular attention to steadiness of motion if the best results are to be obtained.

Suitable Profile for Hump Yards

The speeds developed by cars passing down a given grade under the action of gravity are affected:

1. By the type of car, i. e., whether flat, box, gondola or ore, etc.
2. In the same type of car, by the length of the car.
3. In the same type of car, by whether loaded or empty.
4. In the same type of car, by the lubrication of the car.
5. In the same type of car, by efficiency of maintenance of the car.
6. In the same type of car, by the temperature.
7. In the same type of car, by the time standing before being pushed over the hump.
8. In the same type of car, by the head winds.
9. In the same type of car, by the care with which the tracks are brought to and maintained at the profile grade.
10. In the same type of car, by the timidity or assurance of the car rider.

The last is a human element, but nevertheless affects the operation of a hump.

In 1915 and 1916 the committee circularized the railroads of the United States and Canada for practices and opinions in regard to hump profiles with particular references to the gradients and distance from the summit of the hump to the center of the track scales, with the computed, actual and recommended speeds for motion weighing and the maximum and minimum permissible gradients and the recommended gradient over the scales for best results in motion weighing. The replies covered 80 humps, 22 of which reported scales on the hump and employed motion weighing.

From experience and research the committee is of the opinion that on humps where motion weighing is employed there are two distinct problems, to-wit: (1) The gradients and distance from the summit to and over the track scales, and (2) the gradients and distance from the track scales to and through the ladders of the classification yards. Furthermore, for the same kind of traffic, gradients and distances suitable for a hump in Canada would not be suitable for a hump in Georgia or Florida; and again at a given point, either in Canada or Georgia, or Florida, a hump with distances and gradients below the scales suitable for a traffic of merchandise and empties with many classifications, or with short cuts, would not be suitable in that same place for a traffic of loaded coal or ore cars with few classifications or long cuts.

This leads back to a statement made in the very early discussions of the work of this committee, to the effect that suitable gradients and design for any particular yard are separate and distinct problems for that yard and are dependent upon the location of the yard, the traffic to be handled and the number of classifications.

For the foregoing reasons the committee is of the opinion that no one profile can be recommended as "a suitable profile for hump yards," and a hump constructed on any profile may have to be "tuned up" after it is put in operation to fit conditions.

In general, the committee is of the opinion that the approach grade to a hump should be connected to the summit by means of:

(1) A short steeper grade to bunch the cars and this to (2) a level grade over the summit, these grades to be of such length that they will form the tangents to a reverse curve which shall connect the approach grade to the first grade descending from the summit, which grade shall be (3) a short, steep grade from the summit, to separate the cars quickly and give them the desired speed for weighing, connecting to (4) a light grade over the track scales, connecting to (5) a moderately steep grade, the rate and length of which depends on the traffic, to the head of the ladders, connecting to (6) a grade through the ladders, sufficient to maintain the speed through the turnouts, connecting to (7) a light grade that will just overcome in the length of the body tracks the speed already acquired.

Following this general recommendation and having in mind a traffic of merchandise and empties, the committee recommended three profiles for a mixed traffic of merchandise and empties: No. 1 for cold climates is a suitable profile for hump yards: No. 2 for moderate climates is a suitable profile for hump yards, and No. 3 for warm climates is a suitable profile for hump yards.

Considering the replies and the comments in the letters accompanying them: The recommended speed at the center of the track scales for best motion weighing varied from 1 to 6 miles per hour. The minimum practicable rate of grade on and over track scales, as reported, varied from 0.0 to 1.0 per cent. The maximum practicable rate of grade on and over track scales, as reported, varied from 0.4 to 2.0 per cent. The recommended rate of grade on and over track scales for the best motion weighing varied from 0.0 to 1.5 per cent.

Commitee: E. B. Temple (P. R. R.), chairman; B. H. Mann (M. P.), vice-chairman; W. G. Arn (I. C.), H. Baldwin (C. C. C. & St. L.); G. H. Burgess (D. & H.), A. E. Clift (I. C.), L. G. Curtis (B. & O.), H. T. Douglas, Jr. (C. & A.), A. C. Everham (U. P.), R. Ferriday, E. M. Hastings (R. F. & P.), G. H. Herrold, H. W. Hudson (N. Y. Conn.), D. B. Johnston (P. L. W.), H. A. Lane (B. & O.), F. E. Lamphere (B. & O. C. T.), A. Montzheimer (E. J. & E.), H. J. Pfeifer (T. R. R. of St. L.), S. S. Roberts (Cons. Engr.), C. H. Spencer (I. C. C.), E. E. R. Tratman, E. P. Weatherly, W. L. Webb (C. M. & St. P.), A. J. Wharf (P. & P. U.), J. G. Wishart (C. R. I. & P.).

Discussion

The report was presented by B. H. Mann (Mo. Pac.), vice-chairman.

Mr. Mann: With respect to Subject No. 5, "Make final report on track scale specification," this subject has been before the committee for some time, and the situation is a little peculiar in that the work has been handled by a sub-committee on Standards of the American Railway Association. Mr. Baldwin has handled that matter for the sub-committee with the sub-committee of the American Railway Association, and I will ask him to outline the situation as it now stands, so that in voting upon it we will understand it.

A. S. Baldwin: As has been said by the chairman, these specifications are substantially in accord with the specifications of the sub-committee on weighing of the A. R. A. Committee on Standards. The form of our specifications are somewhat modified, but in such a manner as not to change the substance. There are two points in our specifications which are not exactly in accord with the A. R. A. Committee. At the last joint meeting of the two sub-committees we

were in accord, but subsequently the specifications as printed by the A. R. A. sub-committee were different in these two particulars. The load factor for determining strength and size of main levers is 30 per cent, as we show it, and subsequently to our joint meeting was changed to 25 per cent by the A. R. A. sub-committee.

In the other paragraph, the formula for maximum bending moment in links, we use the formula WL4, and it was agreed at the joint meeting that the printed specifications recommended by the sub-committee and our formula is correct.

Our formula is correct and can be proven mathematically so, and we do not feel justified in following the departure from the specifications agreed upon at the joint meeting. With these two differences as stated these specifications are substantially the same as the A. R. A. specifications. Further than that these specifications were evolved in touch with the Bureau of Standards at Washington, and while the representatives of that bureau specifically avoided any express agreement or approval of the specifications, we were close enough to them in discussing the matter to feel that these specifications are satisfactory to them.

As to moving the adoption by the convention of these specifications, with these minor differences, I am at a loss how to proceed, but I do move the adoption of the specifications.

Mr. Mann: The committee felt that the committee had to outline the work in connection with the Committee of the American Railway Association, and we voted as it is before us now.

The President: If there is no objection this will be adopted and published.

(The conclusions of the committee relative to changes in the manual were adopted by the convention and the committee was dismissed with the thanks of the association.)

Report of the Committee on Roadway

DURING 1915 a circular letter was sent to members of the Association requesting standard roadbed cross-sections, together with their comments on the width of roadbed necessary for proposed increased depth of ballast. Thirty-eight replies were received. With the present 12-in. depth of ballast, shown in the 1915 Manual, it is apparent that it is not necessary to increase the width of roadbed now adopted by the Association.

The Ballast committee considers that 24 in. under the tie is the proper depth of ballast to secure practically uniform distribution of pressure on the roadbed, and that with this depth of ballast the roadbed should be 26 ft. wide.

W. M. Dawley, Chairman

It is the opinion of this committee that, for the Ballast committee's section of 24 in. of ballast under the tie, the adopted standard berm shown on page 55 of the 1915 Manual should be maintained. We do not think, however, that the roadbed sections in the Manual should be revised by eliminating the Class "A" roadbed width of 20 ft., but that an increased width of roadbed should be used for Class "A" track where the depth of ballast under the tie is greater than 12 in.

Three cardinal points should be given careful attention in selecting machinery for roadway construction. These are in their order:

(1) Care in the selection, inspection and acceptance of all material that enters into every part of the machine.

(2) Design for strength and durability.

(3) Design for production.

The prompt delivery of repair parts and the accurate fit of these parts when received, is of utmost importance. This may be best judged by the general reputation of the different makes upon the market, and the supply of repair parts stocked at the nearest depot of supplies. The machine should be so designed, in proportioning the strength of all parts, that breakage will be avoided. This is especially so with an over-powered engine, as a careless operator may easily wreck his machine. The engines and other machinery should not be crowded, or unhandy to get at in case of repairs. The open-frame type of engines are the most desirable. All parts, as far as possible, should be free and not interfere with others so as to cause delay either in case of repairs or when moving.

The boilers should have ample capacity to operate continuously under full load, but the pressure regulation should be such as to eliminate danger of overtaxing the engines or other parts of the machine. Where lugs or braces are riveted to the boiler, or where pipe connections are made, the plates should be reinforced. All parts should be interchangeable as far as possible, and bronze bushings are recommended for bearings in place of babbitt, split bushings being preferred where possible.

Steam Shovels

The size of shovel used for any work must be decided by the character and quantity of excavation and the local conditions. In general, the commonest sizes are 60- to 80-ton shovels for the usual railway work. The following gradient of sizes may, however, be of service: For light grading, up to 25,000 cu. yd. per mile, where a shovel can be used economically, a light revolving shovel is to be desired. For 25,000 to 40,000 cu. yd. per mile, a shovel of about 50 tons is a good size. For 40,000 to 60,000 cu. yd. per mile, a shovel of 60 to 80 tons is well suited. For anything over 60,000 cu. yd. per mile, the shovel may run up to well over 100 tons economically if its transportation is not too expensive, and if the ground is fit to carry the weight on sub-grade during excavation.

Although it is usually unwise to depart materially from the standard design of a manufacturer in purchasing a steam shovel, mainly on account of the increase in cost resulting from such changes, and the liability of delays and other troubles connected with repairs, there are certain special features that are very often worth especially specifying. Also, as these are of distinct general advantage, the universal adoption of such a demand by all members of the American Railway Engineering Association would very quickly make them a standard practice with all reputable manufacturers of steam shovel equipment.

The following list covers the principal items:

(1) As far as practical, all parts now made of cast-iron should be made of commercial cast-steel, except those made of manganese steel or similar alloy.

(2) The following parts should be made of manganese steel or a similar alloy:
Shipper shaft pinions,
Rack on dipper stick,
"A" frame collar,
Dipper breast, lip, teeth bases, teeth, hinges and latch catch.
(3) "A" frame should have bronze bushing.
(4) Swinging circle should have bronze bushing.
(5) All bearings should have bronze bushings instead of babbitt, split bushings to be used where possible.
(6) All sheaves for either chain or cable to be of steel and interchangeable, with bronze or metalline bushings. Rope sheaves should have turned grooves.
(7) All gears, except the shipper shaft pinion, to be of steel with cut teeth.
(8) Shafts and bearings to be the same size as far as possible.
(9) Both air brakes and hand brakes to all wheels.
(10) Double-bolt and yoke design instead of saddle-block "U" bolt.
(11) When a "U" bolt is used, the cross-section area should be increased 50 per cent and flattened to fit the saddle yoke.
(12) An oil pump with forced lubrication in the engine room.
(13) Rocking grates in boilers.
(14) All gears and dangerous moving parts to be guarded.
(15) Standard M. C. B. automatic couplings and M. C. B. trucks.
(16) Standard steel grab-irons, foot-steps and ladders outside house, as in freight car.

There are several radical structural changes that might be suggested, but as structural changes reduce the efficiency of shovel runners who are used to standard equipment and very seriously complicate the matter of repairs, such suggestions are not considered desirable here.

The greatest cause of delay in steam-shovel work is in the removal of the excavated material. Too great care and attention cannot be given to securing proper and ample equipment in the matter of cars and locomotives, and in the proper systematization of service, track, transportation and disposal.

Locomotive Cranes

One of the greatest difficulties encountered when purchasing locomotive cranes arises from the absence of any standard rating for size and stability. At present, the term 15-ton crane, for instance, means absolutely nothing. As a matter of fact, the 15-ton crane of one make often has greater stability under equal loads and radii than a 20-ton crane of another. It is, therefore, recommended that the Association establish a standard rating, so that when a purchasing agent buys a 15-ton crane, American Railway Engineering Association rating, he knows exactly what he is getting in regard to capacity and stability. With this in view, the following general specification is recommended:

"The rating of a locomotive crane shall be given as the net tons that it will lift, with the crane turned in any direction, the center of gravity remaining not less than 3 in. inside of the gage line of the track, when the water tank and coal bunkers are empty and neither rail clamps nor outriggers in use. Furthermore, the center of gravity shall also remain at least 3 in. inside the gage line of the track, with the crane turned in any direction, when the boom is raised to its highest position, the load removed from the hook, the water tank and coal bunkers full, and neither rail clamps nor outriggers in use."

It is also very important that the center of gravity of a crane, under working conditions, be as low as possible, and that the load be as closely concentrated about the center of rotation as possible, i. e., the main counterbalance or ballast should be in the non-rotating lower frame and the overhang of the rotating part be as small as possible. This will require a much heavier crane for a given rating than is often now the case, but will reduce the probability of overturning, which is the source of the greatest damage in locomotive crane operations.

Besides the above matters of rating and stability, there are certain features that are very important in crane design and construction. The following should be borne in mind when selecting a crane for any service where heavy duties and absence of delays are important:

(1) On all, except most restricted yard and shop services, two 4-wheel M. C. B. trucks are most strongly recommended. The wheel base should be as long as possible, and the trucks of very heavy pattern, to withstand the concentrated load on side lifts. M. C. B. automatic couplers with spring-draft mechanism should also be furnished. Standard safety appliances as required by statutes must be provided. Air and steam brakes and hand brakes should also be supplied.

(2) The best propelling mechanism is so designed that all gears are in perfect mesh under all circumstances, i. e., on straight and curved track and under shock, except when purposely disconnected for train haul.

(3) The large rotating gear ring and pinion should be of the best quality steel with cut teeth; forged steel without welds is preferred. The slip-ring design is recommended. It must be remembered that the whole weight of the crane rotator and load is carried on this ring and ample bearing should be provided, either in rollers or trunnions, especially under the boom end of the frame.

(4) All parts of the crane mechanism should be readily accessible. That is, the engines, drums, shafting, gearing, and especially the clutches should be so placed that each may be individually repaired or replaced without other dismantling.

(5) All shafts should be of nickel steel, the same size, and with interchangeable bronze bushings, as far as possible. Split bushings are preferred, where possible.

(6) Drums should be interchangeable, as far as possible.

(7) Drums and sheaves should be large. This greatly increases the life of the cables.

(8) All gears should be of steel, with cut teeth.

(9) All castings should be of steel, where practical. Where cast-iron frames and beds are used, these should be very massive and properly webbed and filleted. Where steel frames and beds are used, however, care must be taken that actual strength and rigidity are not sacrificed to economy in weight.

(10) All sheaves should be of steel, with turned grooves, interchangeable, and have bronze or metalline bushings.

(11) Bolts and rivets at the rotating center should be avoided.

(12) No clutches or friction should be exposed to the weather.

(13) The levers should be simply and conveniently arranged and so located that the operator has a good view of his work.

(14) When the crane operates on parallel tracks, where a side swipe is possible from a passing train, convex mirrors should be so fixed as to give the operator a view back of his crane.

(15) All gears and dangerous moving parts should have safety guards.

(16) Boiler tubes must be replaceable without removing the boiler.

(17) The boom should be built up with the flanges of angles, channels, etc, turned in so as to expose the solid corner to possible blows and abuse.

Methods of Handling Steam-Shovel Work

The type and size of locomotives used on steam-shovel work must depend on the character of the work, the weight of trains, the length of haul and the local conditions. On maintenance work, ordinary road engines are usually well suited, especially if an ample tail track is provided in the pit so that too much shunting

is not required. On construction, where the track is apt to be bad and curves abrupt, the four- or six-wheeled saddle-tank type is preferable, at least near the shovel. If the haul is long and the track is fair, heavier locomotives should be used in transportation.

Two-way side-dump cars are the most useful in general excavation. The best sizes are 12 to 30 cu. yd. They should be equipped with standard M. C. B. double trucks and be provided with both hand and air brakes. When air dumps are not employed the cars should be self-dumping when loaded, self-righting when empty, and have strong and easily-operated hand brakes, with brake wheels instead of cranks. Where wooden bodies are used, these should be heavily reinforced around the upper rim with steel angles, and steel-plated floors are generally desirable, even in earth excavation. The angle of dump should be as steep as possible within reasonable limits of height and re-righting ability.

When cars of small capacity are used, such as 4 to 10 cu. yd., only four wheels are used, although all cars should be spring-borne. In the case of four-wheeled cars, the wheel base should be long and the trucks articulated, if possible, to avoid derailment. All cars should be very substantially built, steel cars usually being preferred.

Convertible cars, which may be used for commercial purposes, are often very valuable, as they may be used both as dump cars and as gondola cars. Flat cars connected with aprons may be used on steam-shovel work where dumpers are not available. When such is the case, steel aprons are used over the bumpers, and an unloading plow is generally used for the dump. The following points should be observed in the selection of flat cars for steam-shovel work:

(1) The car should be strong enough for the purpose.

(2) Brake-wheels should be in good condition, and in case material is to be plowed off, they should be placed at the sides of cars.

(3) Stake pockets should be in good condition and not spaced too far apart. Four feet apart in the center of the car, and closer at the ends, is good practice.

(4) Stakes should be strong enough to prevent accident or the derailment of the plow.

(5) The floors of the cars should be kept in good repair.

Plows and Spreaders

For handling unloading plows, a cable with an auxiliary engine and drum is recommended. The machine should be able to develop 60 tons pull, with steam cylinders 12 in. by 12 in., and a diameter of drum of 4½ ft., permitting four wraps of 1½-in. cable to be made. Steam should be supplied by the locomotive. The winding machinery should be placed on a specially-built or adapted car and protected from the weather.

When raising track, the center plow is recommended when the raise is light; side plows are recommended for making heavy fills or widening the bank.

The plow should be strong and massive. If the mold-board is curved throughout its length so as to make the angle of the entering wedge sharper than that of the tail of the plow, there is less breakage of stakes. The vertical slope of the mold-board should be sufficient to preclude climbing, especially toward the rear, in a side-dump plow. The larger and heavier plows are recommended for general use. The longer the plow and the flatter the angle of thrust the better satisfaction will be gained. The height of the mold-board should not be less than 48 in. on a center plow, or 54 in. on a side plow, and higher plows are usually more desirable.

The size of spreader selected will sometimes depend on special conditions or use, but in general the large size is most useful. For this type of machine the following features are recommended:

Form of spreader, 2 arms.
Pneumatic control by one man.
Maximum spread at least 40 ft., with extensions.
Vertical range of wing operation should be about 2 ft. above and below top rail.
Minimum width 10 ft., wings closed.
Maximum height in train 15 ft., wings closed.
Air and hand brakes.
Front plow to flange 2 inches below top rail, with cast-steel cutting edge and manganese steel wearing plates over rail.
The front plow should have extensions so that all material on track and 3 ft. to one side may be passed across track to the wing on the other side.
The center of gravity of the car should be as low as possible.
The wings should be heavy, strongly hinged and braced low to avoid twist.
In operation, the trucks should be watched and wheel flanges kept in perfect repair.
The locomotive runner should not be allowed to "charge the pile."

It is impossible to establish set rules regarding the point where lifting track should stop and trestling begin when making embankments with trains. The character of the material is of great importance in the matter of cost. Some engineers consider that it is practically always preferable to trestle or block up the tracks without regard to the depth of fill, while others say it is advisable to raise the track as the fill progresses, up to 25 ft. or more. On the average, from 6 to 10 ft. are the commonest limits. With, however, the great fluctuation in the costs of both labor and materials, it is recommended that each case be treated as an individual problem. The cost of raising should be carefully figured, including the delays and interference caused to and by traffic where such exists, and this set against the cost of trestling, including labor and materials. It should be remembered that in some cases a "run-around" can be formed very cheaply, while in other places this requires either an auxiliary fill or trestle.

In estimating trestle for fills over which regular traffic is not to pass, the length of haul is important. Where the haul is less than two miles, light side-dumping cars may be used, and a very light trestle is required. Of course, the geographical location of such work also has an important influence on this question, as climate, character and availability of fill materials, labor, lumber and other supplies vary enormously with different sections of the country. Each engineer, familiar with his own section and the local conditions surrounding the work, is the man to estimate the relative cost and decide where raising track should stop and trestling should commence, either on new location or under existing tracks and traffic.

In determining the allowance for shrinkage to be made in a fill, it should be remembered primarily that it is easier to add to the height of a fill that settles than to lower the track if the settlement does not amount to as much as that anticipated in the original allowance. Therefore, unless the shrinkage of a material is well-known in the conditions under which the fill is made, it is best to be well on the safe side: i. e., little or no allowance should be made in height; the extra material, when possible, being deposited where it will be conveniently available for raising the track, as required. The allowance in width should be from about 5 per cent to 20 per cent of the height of the fill, depending on the material and conditions.

The material used for fill varies in shrinkage from sound, non-disintegrating rock, or gravel, which is least, to certain swelling clays, which give the greatest shrinkage both in compactibility and erosion at the slopes. While vegetable loam has a large percentage of actual shrinkage, it so quickly produces a protection cover of vegetation that the shrinkage due to erosion is usually small. Where frozen material must be used in making

a fill, heavy settlement must be expected, and this is to be avoided where possible.

The material and contour of the ground supporting the fill is also a matter of considerable importance. This is especially so where unstable material is encountered.

The method of making the fill should also be carefully considered. When the tracks are being raised under traffic, the vertical shrinkage will be largely taken care of in the course of the work. When the fill is made by teams or such means as to reasonably tamp and compact the fill in thin layers as it is made, the same is true. Where, however, the fill is made by trestle and without puddling or other method of compacting, the settlement is apt to be considerable.

Prevention and Cure of Water Pockets

On December 8 the Roadway committee was taken by H. T. Porter, chief engineer, Bessemer & Lake Erie, and F. R. Layng, engineer of track, to inspect the 2½ miles of second track which was constructed in 1910 and 1911 and on which the sub-grade was thoroughly rolled with a 10-ton steam roller before screened crushed bank slag ballast was applied. Section men removed the ballast to expose the sub-grade both longitudinally under the rail and entirely across the track at a point where the sub-grade had been rolled, and made a similar exposure at a point similarly situated, where the fill was made with the same kind of clay but not rolled.

A cross-section of the rolled sub-grade taken under a tie showed a depression of from 5 to 6 in. below the surface as originally constructed.

The ballast and clay sub-grade were not mixed. The sub-grade was hard and firm and the rain which fell the night before had left but slight traces of water on the sub-grade. A bucket of water poured on the ballast between the rails flowed freely down to the sub-grade, and out into the excavation made below sub-grade. A longitudinal section under a rail exposing the sub-grade under three ties showed a difference of about 1 in. in the elevation of the sub-grade between ties and under ties, the sub-grade being depressed about 1 in. more under the tie than between ties.

Another cross-section was made under a tie on a clay embankment at the same time, in the same manner and of the same material as that just described, but in this case the sub-grade was not rolled. It was finished in the usual manner, using a Jordan spreader.

This section showed a depression of the sub-grade of from 5 to 9 in. below the surface as originally constructed. The ballast and clay sub-grade were thoroughly mixed, the puddled clay had worked up into the ballast to within 6 in. of the bottom of the tie, small pools of water were standing at this level, which was several inches higher than the shoulder of the embankment outside of the ballast. A longitudinal section under the high rail showed that the sub-grade has been depressed about 1¾ in. more under the tie than between the ties, while a longitudinal section under the low rail showed the depression under the tie to be 1¼ in. more than between ties. The original ballast at the section on the rolled sub-grade was not as clean as the ballast used at the other section, as it contained more fine material near the bottom.

There is a marked difference in the line and surface and in smooth riding over the rolled sub-grade track as compared with adjacent sections, and the rolled section is maintained with less labor.

It seems that the consolidation of the sub-grade by rolling has prevented its mixing with the ballast, notwithstanding the depression of that portion under the ties below the level of the shoulder which has formed a trough with no drainage outlet other than percolation through the sub-grade.

The Erie has arranged to conduct two tests of rolling the sub-grade, one of which will be on an 18- to 20-ft. double-track fill of lumpy blue clay about a mile long, the westerly half to be rolled, the other half to be finished in the ordinary manner. Depression plugs are to be inserted at several points so that the elevation of the sub-grade may be checked at any time without disturbing the ballast. It is the intention to oil the sub-grade after rolling to prevent it from working up into mud and fouling the ballast.

The other test will consist of rolling the sub-grade on a fill 5 to 8 ft. high, composed of light sandy loam, constructed for a new eastbound track. The easterly half of the test section is to be rolled and the westerly half to be finished in the ordinary manner.

The purpose of this test is to determine the effect of the rolling on the cost of maintenance, the present track being hard to maintain in line and surface on account of the light, springy sub-grade causing rails to creep and ties to become slewed.

Both of these test sections are on the Chicago and Erie division of the Erie Railroad where new second track and grade revisions are being carried out between Lomax, Ind., and Griffith. The double track high fill test is located just west of Winfield and the low fill test is located a short distance west of Wilders.

Advisable Slopes for High Rock Cuts 40 Ft. in Height or More

The committee has received replies from a representative number of roads to their questions asked in regard to the above subject and find that general practice calls for a slope of ¼ to 1 in rock cuts on new construction, and the roads report that cuts of that slope in material which can be really classified as rock are standing without trouble. In disintegrated rock or shale or in cuts where stone and shale strata alternate, the slopes must be determined by the nature of the material and each individual case considered on its merits. The committee therefore recommends that new rock cuts 40 ft. or more in height be constructed at slopes of ¼ to 1.

The foregoing statements are based on 65 replies received to a list of questions sent to 225 roads. The replies received include almost all the larger roads that have done a considerable amount of construction work. It appears that a number of roads at present are using a cement gun on cuts where the rock has been badly shattered in construction and where the strata is very much inclined to the horizontal and seamy. This practice should enhance the value of the ¼ to 1 slope, for if the rock is found after construction to be bad and the cut giving trouble, it can be remedied by plastering with the cement gun.

Advisable Width for Newly Constructed Roadbed on Embankment 50 Feet High or More

Almost all of the roads reporting say they are making no allowance in increased height for anticipated settlement of embankment, as in the past anticipated settlement has not occurred, and it is better to hold track to grade on additional material than to spend quite a sum of money to cut bank down. The committee recommends, therefore, that no allowance be made for increased height of embankment 50 ft. or more in height, and that the following allowances be made for increased width of embankment 50 ft. or more in height: Anticipated shrinkage 7 per cent, add 10 per cent of vertical height to each shoulder or fill; anticipated shrinkage 10

per cent, add 15 per cent of vertical height to each shoulder of fill; anticipated shrinkage of 15 per cent, add 22½ per cent of vertical height to each shoulder of fill. If these allowances are made, there will be the proper bank and shoulder after shrinkage has occurred to rebuild the sub-grade to its normal section and permanent standard width without widening the entire embankment. Each individual case should be decided on its own merits, and depends on nature of material and manner of placing same. It is felt by the committee that no embankment 50 ft. or more in height will be constructed in any other manner than by dumping from a trestle, and these figures are recommended as applicable especially to this method of placing in embankment.

ADVANTAGES AND DISADVANTAGES OF TRACK ELEVATION AND TRACK DEPRESSION IN CITIES WHERE MANY STREET CROSSINGS MAKE IT NECESSARY TO CHANGE THE GRADE OF THE RAILWAY.

THE ADVANTAGES AND DISADVANTAGES IN DEPRESSING OR ELEVATING STREETS WHERE A FEW CROSSINGS ARE TO BE ELIMINATED WITH BUT SLIGHT CHANGES IN THE GRADE OF THE TRACKS.

Whenever grade separation through densely built-up thoroughfares (short blocks, say 12 to 15 crossings per mile) becomes imperative, elaborate studies of the kind and volume of traffic on each thoroughfare should be made and due record kept, with a view of eliminating or vacating certain of these crossings as wholly unjustifiable from a cost standpoint, and lateral streets at a less cost may be opened in their stead. If but a very few crossings are to be eliminated in an industrial district, with reasonable assurance that no others will be required, other things being equal, the method used should not disturb the tracks. If several crossings are to be eliminated in an industrial district, other things being equal, the most efficient method is by track elevation.

In a residential district, if grades and other conditions on the railway will permit, complete depression allowing the streets to remain at their original level, or nearly so, is the preferable method.

THE EFFECT OF FAST TRAINS ON THE COST OF MAINTENANCE OF WAY AND OF EQUIPMENT

The committee has found it impracticable to obtain any information of a reliable character, the system of accounts in use on American railways not being adapted to this purpose. While it is possible to obtain the cost of ties, except labor, rail and ballast applied to the tracks in question, no other information can be had which would be of any value.

From the meager information at hand it appears that the cost of maintaining fast track is greater than that of slow, by the following percentages:

Rail, 1 per cent annually.

White oak ties, 3 per cent annually.

Cedar ties, 4 per cent annually.

When this new data is in hand it may be possible to give a more reliable figure on the effect of speed on cost of maintenance of track.

The effect of speed on maintenance of equipment is much more difficult to determine. Rolling stock is indiscriminately used in both fast and slow service where of the ordinary kinds, and where used exclusively in high-speed service is usually of a superior order of construction and not comparable with the class of equipment used in slow-speed service. Locomotives for high and low speeds are of different designs and have different maintenance costs, even though used at same speeds.

Committee: W. M. Dawley (Erie), chairman; J. A. Spielmann (B. & O.), vice-chairman; J. R. W. Ambrose (Toronto Terminals), H. E. Astley (N. Y. N. H. & H.), C. W. Brown (L. & N. E.), S. P. Brown (Mt. Royal Tunnel & Terminal Co.), B. M. Cheney (C. B. & Q.), C. W. Cochran (C. C. C. & St. L.), W. C. Curd (M. P.), Paul Didier (B. & O.), S. B. Fisher (M. K. & T.), L. F. Lonnbladh (M. K. & T.), H. W. McLeod (C. P.), C. M. McVay (K. & M.), F. M. Patterson (I. C. C.), W. H. Petersen (C. R. I. & P.), P. Petri (B. & O.), W. F. Purdy (Wab. Pgh. Term.), R. A. Rutledge (A. T. & S. F.), J. M. Sills (St. L.-S. F.), H. J. Slifer (Cons. Engr.), G. R. Talcott (B. & O.), W. P. Wiltsee (N. & W.).

Discussion

The report was presented by J. A. Spielmann (B. & O.), vice-chairman of the committee.

Mr. Spielmann: The first subject treated is (1-a) "Roadbed cross sections." (Mr. Spielmann then read the conclusions, which were adopted.)

Mr. Spielmann: There is a revision of the recommendations relating to steam-shovel work and to shrinkage or expansion of materials placed in embankment by ordinary methods of railway construction and to settlement thereafter, and especially with reference to steam shovel and other apparatus for grading.

We have quite a lot of information asked for, confidentially, from manufacturers, which we do not publish in this bulletin and we do not think it ought to be given out, but recommend that it be placed in the archives of the association, where it can be accessible to the members. We also have information from contractors and some special railroad people.

The President: It is understood that this information will be on file among the records in the office of the secretary and can be had by members when the secretary is consulted.

Mr. Spielmann: The recommendation of the committee in this regard is for the substitution or revision of the manual in regard to steam shovels and other apparatus for that kind of work of the manner we have presented, and we have also submitted some forms for adoption in place of those now in the manual.

There is one correction to be made under locomotive cranes. It should read: "The rating of a locomotive crane should be given as the net tons that it will lift at a 12-ft. horizontal radius."

The President: That correction will be made in the proceedings. You have before you these recommended forms. What is your pleasure?

Mr. Spielmann: I move that the forms be adopted in place of those now in the manual.

The President: Is there any discussion in regard to these forms?

(The motion was carried.)

Mr. Spielmann: Our report on Subject No. 2—"Continue the study of unit pressure allowable on roadbeds of different materials, co-operating with special committee on Stresses in Railroad Track," is a progress report.

In regard to the curing of water pockets, we know that there are a great variety of water pockets. We have a mass of correspondence from different railroads on this subject. There are some cases where engineers reported how they cured water pockets and even furnished diagrams, and they reported they were a success, but before the end of the year we had some reports from the same parties stating that they were meeting with failure and the plans did not work out. This, of course, is submitted as a progress report.

We refer to subject No. 7, which is "Report on the

effect of fast trains on the cost of maintenance of way and maintenance of equipment." This committee made some progress in getting up a report on this subject, based on some investigations, but we are a little bit in doubt as to whether this belongs to the Committee on Roadway or whether it should not be referred to the Committee on Stresses in Railroad Track.

The President: That can be passed on by the directors. If there is no further discussion, the committee is dismissed with the thanks of the association.

Report of the Committee on Buildings

IN presenting its report last year, there was some confusion regarding whether it was presented as information or for adoption in the Manual. For this reason it was referred back to the committee and was presented for adoption this year in practically the same form as last year and as published in the *Railway Age Gazette* of March 24, 1916.

M. A. Long, Chairman

The first part of the report was devoted to freight house scales. In outbound houses it is desirable to have a scale at every second door opening, or a maximum of 75-ft. centers, these to be located approximately 6 to 8 ft. from the receiving side of the house. In inbound houses it is desirable to have scales placed 100-ft. centers, as the maximum, and located on the receiving side.

In layouts where one house handles both inbound and outbound freight, and where the business is heavy and diversified, the scales should preferably be located at every second door opening, or a maximum of 75-ft. centers. Where this number of scales are used they should be ample to take care of outbound weighing. Scales should be located on the driveway side of the house.

At small outlying stations where there is a combination baggage and freight room, a fixed scale with the platform level with the freight room floor, located preferably at one side of the door nearest the driveway side, is recommended, as at this point it will be less liable to damage from trunks or large packages.

Scales for houses handling freight only should have a minimum capacity of four tons. Higher capacity scales cost very little more and are economical from an operating and maintenance standpoint, as they will stand up better under the abuse to which they are usually subjected.

Ash Pits

The report also repeated the information concerning ash pits presented last year, including a brief general discussion of the service to which ash pits are subjected, with the alternate heating and cooling of the walls and the action of the acids, etc. Five different types of pits were presented for use under conditions ranging from the simple pit of cast-iron tie construction to the elaborate flooded pit served with an overhead gantry crane.

Committee: M. A. Long (B. & O.), chairman; G. H. Gilbert (Soo), vice-chairman; G. W. Andrews (B. & O.), D. R. Collin, W. H. Cookman (P. R. R.), C. G. Delo (C. G. W.), W. T. Dorrance (N. Y. N. H. & H.), K. B. Duncan (G. C. & S. F.), J. H. Edwards (Am. Br. Co.), C. H. Fake (M. R. & B. T.), J. B. Gaut (G. T.), E. M. Grime (N. P.), A. T. Hawk (C. R. I. & P.), F. F. Harrington (Va.), E. A. Harrison (A. T. & S. F.), C. A. Hayes (M. & O.), A. Larson (S. N. E.), R. V. Reamer (C. R. R. of N. J.), H. Rettinghouse (C. St. P. M. & O.), C. W. Richey (P. R. R.), John Schofield (C. N.).

Discussion

The proposed revision of the manual was approved, after which freight house scales were discussed.

C. E. Lindsay (N. Y. C.): I think that the plan proposed hardly leaves room to enable the man to unload his wagon, between the side of the house and the scale, and let anybody else stand with a truck ready to put the stuff on the scale. I think it should be a little further.

Mr. Long: If you have it farther away from the door, it means more handling. We have a scale at every second door opening. The closer you have the scales to the door the simpler it will be, provided there is no congestion of freight.

Mr. Lindsay: That is true if the packages are small, but when you get into dry goods there are big boxes.

Mr. Long: We found that there was likely to be congestion if the scale were in the center of the house, on account of double handling.

(Mr. Long read the portion referring to ashpits.)

Mr. Lindsay: I suppose that is in line with safety work, but it seems to me we are going crazy on the safety question. I remember reading about how a man on the Delaware & Lackawanna fell into a pit and was drowned. Is there any more reason why a man should fall into a pit walking lengthwise of the track than there is if he is walking sideways?

Mr. Long: Rails are all around the pit except where the track enters. The idea is to have a three-foot drop. He would walk down this grade, and when he got to the fifteen feet, his feet would be three feet below the level, and there would be something to stop him. We have had four men drowned walking into the pit. The committee would recommend in a general way that this be followed out in pits as a safety proposition.

Earl Stimson (B. & O.): I think 15 ft. is a little too long. We have provided protection 8 ft. in length in a number of the pits, and it is successful.

Mr. Long: We felt that at times the cinders would fill it up. We felt, in having this 15-ft. extension under the rail, extending out from the pit, the water would be sufficiently hot so it would not freeze, and if the man walked into the pit it would be with notice.

Mr. Stimson: Under various types of pit, you say, "At outlying districts, where few engines are handled, cast-iron ties, approximately 12 in. high, are used to prevent burning wood ties. These should be located on spur tracks." We are using them on other tracks.

Mr. Long: The committee did not feel that you could use a cast-iron tie on anything but a spur track.

Mr. Stimson: I would move that that be amended to read not more than 5 ft. below the drainage pipe and

don't specify any depth at all. That will limit it so that the usefulness of that pit would be destroyed.

(The motion was carried.)

Mr. Lindsay: Then this ought to be confined to water pits.

Mr. Long: What I had in mind was to have this for all pits in general, but we will put in the words "water type of pit."

The Chairman: Would it not be well to place the rail the same as the crossing, only one rail instead of double rail, 8 ft. from the pit. I don't agree with Mr. Lindsay that there is no more danger of a man falling in walking along the track than walking alongside of the track, but if there is a rail 8 ft. away he will stumble against it.

Mr. Long: The objection to that would be the same as the objection to the cattleguard or other things. It would fill up with snow and ice, and lose its effectiveness.

The Chairman: One or two of my engineers were going to offer a few objections to this report, but they are not here. We are using a cast-iron pedestal on which we place two rails, set in this cast-iron, and we have not had any wrecks. This gets rid of the objection to disintegrating of the concrete. If you have not had copies of the plans I will send them to you. The committee is dismissed with the thanks of the convention.

Report on Economics of Railway Location

THE committee was instructed by the Board of Direction to make a study and report on certain subjects during the year, as follows:

1. Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes, taking into special consideration a revision of the conclusions in Vol. 16, pages 104 to 109.

2. Report on the resistance of trains running between 35 and 75 miles per hour.

3. (a) Report on the effect of curvature on the cost of maintenance of way. (b) Report on the effect of curvature on the maintenance of equipment.

4. Report on the effect of train resistance on the amount of fuel consumed.

5. After the study of the effect of the various physical characteristics of railway locations upon their economy of maintenance and operation has been made, if it is possible to do so, state the conclusions derived from these studies in a formula, or series of formulas, which can be used by engineers in determining the relative efficiency of various locations.

6. Report on the entire question of economics of location as affected by the introduction of electric locomotives.

7. Report on the extent the locating engineer is justified in making additional expenditure in getting nearer to medium-sized centers of population already in existence in the territory where the road is to be built.

John G. Sullivan, Chairman

Considerable work has been done on each of the foregoing topics, but with the exception of revision of the manual, the committee is not prepared at this time to submit definite conclusions for approval.

The committee has made a careful study of the conclusions now incorporated in the Manual and presented changes in phraseology and rearrangement so as to make the matter clearer.

Pertaining to "the effect of train resistance on the amount of fuel consumed," the chairman of the committee has made a study of fuel consumption on several divisions of the road with which he is connected, and the results of that study were placed at the disposal of the members in Bulletin 187, for July, 1916. (Abstracted in the *Railway Age Gazette* Sept. 1, 1916.)

Prof. Edward C. Schmidt made a series of train resistance tests on Illinois Central through-passenger trains. The tabulated results were appended to the report as Appendix A. (Abstracted in the *Railway Age Gazette* of March 9, 1917.)

Committee: John G. Sullivan (C. P.), chairman; C. P. Howard (I. C. C.), vice-chairman; F. H. Alfred (P. M.), Willard Beahan (N. Y. C.), R. N. Begien (B. & O.), G. D. Brooke (B. & O.), Maurice Coburn (P. L. W.), D. F. Crawford (P. L. W.), W. J. Cunningham (B. & M.), A. C. Dennis (Contr. Engr.), R. D. Garner (S. N. E.), A. S. Going (G. T.), F. W. Green (St. L. S. W.), V. K. Hendricks (St. L.-S. F.), H. C. Ives (Worcester Polytechnic Institute), Fred Lavis (Cons. Engr.), J. deN. Macomb, Jr. (A. T. & S. F.), G. A. Mountain (Can. Ry. Com.), W. G. Raymond (Univ. of Ia.), S. S. Roberts (Cons. Engr.), E. C. Schmidt (Univ. of Ill.), A. K. Shurtleff, L. L. Tallyn (D. L. & W.), Walter Loring Webb (Cons. Engr.), H. C. Williams (L. & N.), M. A. Zook (I. C. C.).

Discussion

Mr. Sullivan (chairman): I think the better way is to make a few comments on Subjects 2 to 7 as we go along and then come back to Subject 1, the only one on which we have conclusions.

With reference to Subject No. 2, "Report on the resistance of trains running between 35 and 75 miles per hour," Mr. Begien was chairman of the sub-committee dealing with that matter, and he reported that he had made some experiments, but did not wish to have them published, as he felt that there might have been some inaccuracies.

With regard to Subject No. 3, "(a) Report on the effect of curvature on cost of maintenance of way; (b) report on the effect of curvature on maintenance of equipment," there was a sub-committee formed to deal with that problem, but they realized, as I think all of you will realize, that it is a hard subject to get on a dollar and cents basis.

As to Subject No. 4, "Report on the effect of train resistance on the amount of fuel consumed," Mr. Crawford, the chairman of the sub-committee dealing with that matter, was a little too busy to do much work on this subject.

Concerning Subject No. 5, "After the study of the effect of the various physical characteristics or railway locations upon their economy of maintenance and operation has been made, if it is possible to do so, state the conclusions derived from these studies in a formula, or series of formulas, which can be used by engineers in determining the relative efficiency of various locations," we had a meeting on that subject, and those who were present at the meeting were unanimously of the opinion that we were not quite ready to reduce our results to a formula at the pres-

ent time, and that probably that subject could be deferred until such time as we were publishing a new manual.

As to Subject No. 6, "Report on the entire question of economics of location as affected by the introduction of electric locomotives," I am not certain that that is a subject we could deal with very satisfactorily. In fact, it might have been better if that subject had been given to the Committee on Electricity. We have not been able to do any work on that subject, and I am afraid that we must ask to be excused from dealing with it.

As to Subject No. 7, "Report on the extent the locating engineer is justified in making additional expenditure in getting nearer to medium-sized centers of population already in existence in the territory where the road is to be built," that is a subject which the committee did give some thought to, but no conclusions were arrived at, and a general synopsis of the opinions of a part of the committee, at least, would be about as follows:

"I doubt very much if this association can lay down definite rules for the guidance of engineers, for the reason that every case is a problem by itself."

L. C. Fritch (Can. Nor.): I have not given the matter much consideration—it is a pretty broad subject. It seems to me it is hard to lay down fixed rules to govern all points. I think Mr. Sullivan's idea in taking an ideal case and figuring it out on the basis he has is the only rational way of figuring. Of course, there are other elements which must be considered in connection with it. I think some lines have made the mistake in sacrificing distance and alinement and in that way have missed small centers of business that would yield quite a return. Of course, the character of the country has something to do with it. I should say, though, if two lines are already serving a location such as Mr. Sullivan has chosen as his illustration, and a third line comes along, it is almost necessary by reason of competition to arrive at the same centers already served by the competing line.

I think that is a very valuable study and I believe if we took the existing lines and got actual figures it would demonstrate which policy is the right one to pursue.

Mr. Sullivan: It is true, as Mr. Fritch has stated, that the statement I made here was on the side of being favorable to going into these smaller towns. There are other factors. It is not good policy to miss a town if you can help it. You will bring discredit on the road, and furthermore you must consider the future growth of that town. The policy is governed not so much by the locating engineer as it is by other considerations, and this is a matter of policy. It is true that the locating engineer, or chief engineer, if he is in charge of location, should be properly informed, and he should be able to advise his board of directors if they are making an uneconomical location.

Mr. Fritch: There is one other point. There are many illustrations where through lines have been built, and then spur lines built into the smaller centers. That is shown in many cases to be a very unprofitable investment. It costs a lot of money to operate a small branch line.

The President: If there is no further discussion, this portion of the report will be accepted as information and we will return to Instruction No. 1.

Mr. Sullivan: Instruction No. 1 reads as follows: "Make critical examination of the subject matter in the manual, and submit definite recommendations for changes, taking into special consideration a revision of the conclusions in Vol. 16, pages 104 to 109." The committee was under the impression that to get any matter before the convention it should be put in the form of conclusions. We were not unanimous at the meeting we had as to the changes suggested in the manual, but they were allowed to go into the report, and since the report was printed I have had considerable correspondence with some of the members who objected to changes.

(Mr. Sullivan then read the first change under "Revision of Manual," which was agreed to.)

(Mr. Sullivan then read the proposed changes to paragraphs (3) and (4), page 521 of the manual, which would make them read: "An economical location is one which permits the production of the greatest return on the investment from the profits of operation.")

Mr. Sullivan: There is considerable objection to this proposed change, and I think you will remember that there was considerable discussion a year ago on this subject when it was first introduced into the manual. The difficulty arises on this point—if a road was built as a private institution with your own money without borrowing money, the greatest interest you could get from that money would probably be represented by the formula $R - E$, divided by C equals p, which is in the present form. The second formula, $R - (E + I) = P$, contemplates a different case, where you can get money possibly at low rates and sell bonds. There can be cases where that second formula may not be exactly true. We might change that to read $R - (C + p)$, C being the capital and p the interest you pay, that is, practical fixed charges, plue E, the expense, and then subtract from that your receipts, which means dividends. You can get a case where by increasing p you will also reduce E, and your dividends will be larger, and that is practically the same formula as is shown where $R - (E + 1) = P$, the dividend.

Mr. Sullivan: I do not think the formulae give any misinformation, and in order to bring the matter before the house, I make a motion that no change be made in the manual under paragraphs (3) and (4), page 521.

Mr. Fritch: I think there are cases where the most economical location would be one where the cost of construction, and therefore, the interest, would be less. If your gross receipts are not sufficient on a certain line to pay your fixed charge and operating expenses, it would be much wiser to build a less expensive line and thereby decrease the capital account and interest charges and thereby produce, probably, a better result in the way of net earnings from the investment.

Mr. Sullivan: Formula 2 covers that case. It shows that dividends are derived from the equation where the receipts, minus some of the earnings, the expenses and the fixed charges, equal the dividend.

Prof. W. C. Raymond (University of Iowa): The chairman of the committee has very frankly said that the committee is not unanimous on this proposition, and perhaps that is sufficient warrant for objection to the motion on the part of a member of the committee. It appears to me that neither of the formulae in their present form, nor the statement in the proposed form, are to the point. I think neither is correct. For that reason, I would move, as an amendment, that the matter be referred back to the committee for further consideration.

Mr. Sullivan: Mr. Raymond's amendment will have the same effect that my original motion had, namely, to leave the matter as it stands at present.

Mr. Roberts: Dean Raymond will support the recommendation of the sub-committee provided it was made to read "The most economic location is one which per-

mits the production of the greatest return on the investment from the profits of operation."

Mr. Sullivan: As to the term "greatest return," do you mean in percentage? If you mean in percentage, that would not be true.

Mr. Roberts: I cannot see clearly how you can have an economic line, unless you get the greatest return on the money invested. I think that this statement as amended by Dean Raymond comes more nearly representing a true statement of what is an economic location.

Mr. Sullivan: If we are able to make 10 per cent on our investment the net earnings would be 10 per cent on the capital spent. If we had spent twice the money the profits might be so reduced that we could not make 10 per cent; we might only make 8 per cent, but the 8 per cent on the straight double sum would give the stockholder more dividends, and that is expressed in the second formula.

Mr. Fritch: Are not we losing the real point of this argument? It does not seem to me it is a matter of finance at all. It is a question of engineering. A railway is a system to perform certain things. Is not the most economically-built railway the one that can handle a given traffic with the least cost, and why confuse that problem with any financial propositions?

The President: My understanding was that the matter was to be referred back to the committee.

(The president then put to vote the matter of referring this part of the report back to the committee, and it was passed.)

(Mr. Sullivan then read the proposed change in paragraph (5), pp. 521, 522 of the manual, which were approved.)

(Mr. Sullivan then read the proposed change to paragraph (8), p. 522 of the manual.)

Mr. Sullivan: There was considerable discussion on that subject. The original report was written about as the sub-committee proposes it, but at the convention it was changed to the language in which it now appears. There is a serious question if this is altogether a desirable instruction.

That paragraph was placed in the manual after considerable discussion, here on the floor of the convention, and I make a motion that no change be made in paragraph (8), p. 522 of the manual.

(Motion put and carried.)

(Mr. Sullivan read the proposed amendment to paragraph (9), pp. 522, 523 of the manual.)

Mr. Roberts: I make a motion that the recommendation of the sub-committee be adopted. (Carried.)

(Mr. Sullivan read the proposed change to paragraph (11), pp. 523 and 524 of the manual, which was adopted.)

(Mr. Sullivan read the proposed change to paragraph (12) and (13), pp. 524 to 526 of the manual.)

(The recommendation of the committee was adopted.)

The President: Before this committee is dismissed, I would like to entertain a motion on the part of the convention to thank Mr. Sullivan for his excellent monograph on fuel consumption which he referred to so modestly and likewise the monograph by Prof. Schmidt on Passenger Train Resistance.

C. E. Lindsay: I am very glad to make much a motion.

(Motion seconded and carried, the committee is dismissed with the thanks of the association.)

Report of Committee on Records and Accounts

AFTER making a careful examination of the subject-matter in the Manual under the chapter of "Records and Accounts," the committee recommended rearrangement and a number of changes, and some additional forms.

W. A. Christian, Chairman

Small Forms for Use of Fieldmen in Making Daily Reports

The comimttee was instructed to make a study and submit "small forms on cardboard or other suitable material for use of fieldmen in making daily reports, to the end that supervision may be facilitated and efficiency encouraged." A series of such forms illustrating the practice of several roads was submitted as being suitable for the purpose for which they were designed. The size of the series of small forms presented was uniformly 5 in. by 8 in., suitably ruled, so that they can be placed in a card index or other file.

Desirable Changes in the I. C. C. Classifications of Accounts Covering Road and Equipment and Operating Expenses

The committee is of the opinion that frequent changes in these classifications are not desirable. While the present Classifications are susceptible to improvement in minor matters, it is thought that no changes should be made just now. Undoubtedly some of the valuation inventories have been classified in accordance with the sub-divisions of the present road and equipment classification, and to change those sub-divisions would mean either reclassifying these inventories or having some inventories sub-divided under the present and others under a new one.

In the meantime our thought is that suggestions for proposed changes can be submitted for discussion and which can serve as a basis or guide when the railways and the Interstate Commerce Commission are ready and desirous of reviewing the classifications in question, and it is along these lines that the following suggestions are submitted for consideration:

Sub-division No. 1, Engineering:

(*A*) Architects' fees: Fees paid to outside architects should be classified under this sub-division.

(*B*) Clerks: The pay of clerks at the headquarters of a chief engineer who compile the field or division reports and audit for the accounting department, should not be classified as a part of the cost of engineering, but, on the other hand, should be classified under sub-division No. 72, General Officers and Clerks.

Sub-division No. 2, Land for Transportation Purposes:

(*A*) Borrow pits: If the pit is not adjacent to the right-of-way, or would not be used for right-of-way purposes after the material has been removed, it would seem that its cost should be charged to No. 3, Grading, and perhaps a value (nominal) for the land itself should be charged to No. 705, Miscellaneous Physical Property.

(*B*) Damages to property of others: Unless the damages are paid in connection with the acquisition of land for right-of-way purposes, we do not believe they should be classified under this sub-division, but, on the

other hand, a new sub-division should be established for items of this kind, the title of which might be "Damages to Property." (See Injury to Persons.)

In the list of items include: (*A*) "Easements, perpetual, or those continuing for a considerable period of time." (*B*) Cost of building new facilities for the seller of land, when their cost is all or part of the consideration for land purchased.

Sub-division No. 3, Grading:

The requirement of separating grading (filling or cutting down hills) as between that required for roadway and station grounds is one that perhaps should receive some consideration. Take the case of a large terminal yard, which would involve miles of track as well as an engine house plant. It would seem unnecessary to attempt to ascertain the small amount of grading required for the engine house, but, on the other hand, charge all grading to sub-division No. 3. Excavation for foundations would, of course, be classified under a building sub-division.

Sub-division No. 6, Bridges, Trestles and Culverts:

Dividing the cost of bridges carrying carrier's tracks over streets (refer to note "B"), a case in point being a stone viaduct carrying tracks over a number of streets, which involves arches over the streets and retaining walls between the arches, being one continuous stone structure.

In a case like this, why not charge the entire structure, including arches over streets and retaining walls between them, to one account, and for that purpose either amend sub-division No. 7 by calling it Elevated Structures and Viaducts, or eliminate No. 7, and put both viaducts and elevated structures in No. 6? Note.--We prefer eliminating No. 7. The filling material placed in the viaduct should, of course, be charged to No. 3, Grading. Stone viaducts carrying tracks over streams or ravines would ,of course, be classified as bridges.

Sub-division No. 8, Ties:

Should be amended to include the excess cost of treated over untreated ties, although this is really an accounting problem.

Sub-division Nos. 73 to 77, inclusive:

Establish a new account for injuries to persons for the reason that we believe that intangibles like injuries to persons and damages should be carried in separate accounts, and which, if done, will materially assist in analyzing cost of road. Corresponding changes to be made in the operating expense classification.

Specifications for Maps and Profiles

Right-of-Way and Track Maps: Twenty-four inches by 56 in.; single line border 23 in. by 55 in.

Station Maps: Twenty-four inches by 56 in., single line border 23 in. by 55 in. When more than one sheet is requred to show a staton property, the plat shall be made upon "matched marked" sheets in such manner as to require the minimum number.

Record Profiles: Plate "A" tracing cloth 12 in. by 56 in., single line border 10 in. by 55 in. All other sizes of drawings to be determined by each individual road and to be as far as possible multiples of correspondence, size or other basic units.

Scales

Masonry and Building Plans: One-eighth inch, ¼ in. or ½ in. equals 1 ft.

Detail Plans of Buildings: Scales should depend upon character of plans.

Right-of-Way and Track Maps: One inch equals 100 ft., 200 ft. or 400 ft., but the same scale should be used throughout each valuation section.

Station Maps and Track Layouts: One inch equals 100 ft., or, in complicated situations, 1 in. equals 50 ft.

Individual Right-of-Way Maps: One inch equals 200 ft., 100 ft. or 50 ft., as may be necessary.

Maps of Surveys: One inch equals 400 ft., or 200 ft. when practicable, and when necessary 1 in. equals 100 ft. Reductions of same, 1 in. equals 1,000 ft.

Profiles: Plate "A" vertical, 1 in. equals 20 ft.; horizontal, 1 in. equals 400 ft., except on ballast profiles, the vertical scale to be 1 in. equals 4 ft.

Condensed Profiles: Vertical, 1 in. equals 200 ft.; horizontal, 1 in. equals 1 mile, except where other scales are necessary.

Track Charts: Horizontal, 1 in. equals one-half mile; vertical, 1 in. equals 100 ft. or 400 ft.

Titles: To be placed as near the lower right-hand corner as practicable.

The following information to be shown for right-of-way and track maps, station maps and record profiles:

(1) Class,
  (a) Right-of-way and track map.
  (b) Station map,
  (c) Profile.
(2) Corporate name of railway.
(3) Name of operating company.
(4) Name of railway division or branch line.
(5) Beginning and ending of survey station numbers on sheet.
(6) Scale or scales.
(7) Date as of which maps or profiles represent the facts shown thereon
(8) Office from which issued.

Titles for all other drawings to conform to the practice of each individual road.

A note referring to drawings, note-books or other data used in compiling to be shown on each drawing.

Orientation

The tops of maps should be to the north or east, according as the general direction of the line is east and west, or north and south. (The existing stationing to be preserved wherever practicable, adjacent stationing being extended in the same direction over unstationed intervals.)

On each end of each sheet there shall be shown a pointer directing to a terminal or important station.

The symbols used on all maps, profiles and plans shall be the standards recommended by the American Railway Engineering Association, in so far as they may be applicable.

On all maps an arrow showing the true north and south line (as nearly as can be ascertained from existing records) shall be placed.

On all maps and profiles to be submitted to the Interstate Commerce Commission, black only shall be used, except that the ruling of profiles shall be in orange ink.

Information to Be Shown

Maps of Surveys: Show all surveyed lines; points of curve to be marked by radial lines, on which stations and plusses are to be given. Legends to be placed between the radial lines, giving the degree and central angle of a simple curve and the central angle of each spiral. Also show contours where necessary at intervals of 5 ft.; all streams, rivers, etc., indicating the direction of current by an arrow, and the approximate area of opening required. Also property lines, buildings of all kinds, pole and pipe lines, fences, roads, existing

railroads, bridges, drains, sewers, manholes, conduits, culverts, areas of existing openings below high-water marks and any other necessary data within the limits of the survey. Names of cities, towns and stations; county, township and state lines to be distinctly marked. The distance from each end of the survey to some point easily located on county or state map, or when survey connects with an existing railroad, name of and distance to nearest station to be given. Where tracks are shown, points of switches and points of frogs to be marked, and frog numbers noted.

Profiles of Surveys

Show ground lines, surface of streams, rivers, etc., depth of same, elevations of high and low water line, sub-grade lines showing rate of grade and elevations at all points of change of rate, and station numbers. On the line below profile show the alinement, using a full line for tangents and broken line for curves, showing the degree and direction of same, total deflection and plusses at beginning and ending of simple curves and spirals. Divisional lines shall be shown on this alinement, and names of property owners. Give distances from the ends of the profile to the nearest city, town or station. When estimates are shown, note the width of roadbed and list quantities in cuts and fills, tunnels, bridges, pipes, crossings, etc., classified in the order given on estimate sheets, also a table of quantities for each section. All elevations shall refer to U. S. Geological Survey datum or other Government precise level bench marks based on sea-level datum.

Tracks in all cases to be represented by single lines, except on plans of 50-ft. scale or larger; where it is necessary to show the rails, double lines may be used. Indicate each track on interlocking plans by a double line.

Record Plans

All masonry records to be drawn to such a scale as will show clearly all dimensions as built, elevations of foundations, neat lines, bridge seats, base of rail, surface of water and ground line, length of piles or elevation of points and the number driven. Clearance is to be shown when crossed by railroad, road or street. In all cases give quantities in final estimate, location and station numbers.

Right-of-Way and Track Maps

A right-of-way and track map shall be a true horizontal projection of the right-of-way, tracks and other structures platted continuously between district or terminal points. For each series of right-of-way and track maps there shall be made a small skeleton index map on a scale of not less than ¼ in. equals 1 mile. Where practicable, this index map may be placed on any vacant space of the first sheet of the series, and where made on a separate sheet it shall be 24 in. by 56 in. All right-of-way and track map sheets shall be numbered serially, beginning with Sheet 1. The sheets representing valuation sections shall form separate series, and the valuation sections shall be numbered serially with the letter "V" preceding the number.

Station Maps

The station maps shall be supplemental to the right-of-way and track maps for terminals and other locations where the property is so extensive and complicated that it cannot be clearly shown thereon. The station maps shall be made as prescribed above for right-of-way and track maps. When more than one sheet is required to show a station property, the plat shall be made upon "match-marked" sheets in such manner as to require the minimum number. The station maps shall be given the same serial number preceded by the letter "S" as the sheets of the right-of-way and track maps which they supplement.

The purpose of the large scale station maps is to permit the showing of improvements in more detail than is practicable on the right-of-way and track map. Where the station property to be mapped is extensive and complicated, it may be delineated on two separate maps. (1) Shall show all data relating to ownership of lands. (2) Shall show all tracks and structures and external land boundaries.

Committee: W. A. Christian (I. C. C.), chairman; M. C. Byers (W. M.), vice-chairman; F. L. Beal (L. & A.), Lester Bernstein (B. & O.), H. Bortin (C. R. R. of N. J.), W. S. Danes (Wabash), G. D. Hill (N. Y. C.), Henry Lehn (N. Y. C.), J. H. Milburn (B. & O.), J. C. Patterson (Erie), J. H. Reinholdt (M. & St. L.), R. C. Sattley (C. R. I. & P.), Guy Scott (P. L. W.), Huntington Smith (N. Y. C. & St. L.), H. M. Stout (N. P.), R. E. Warden (M. P.), J. M. Weir (K. C. S.), W. D. Wiggins (P. L. W.).

Discussion

W. A. Christian (Chairman): On the subject of desirable changes in the Interstate Commerce Classification accounts covering road equipment and operating expenses, the committee submits discussion, and this report is open and the committee would be glad to have it discussed so as to get all the information they can.

The President: Are there any suggestions in regard to this on pages 754 and 758, inclusive?

Mr. Rose: One change I have in mind is the track laying surfaces. I find the cost of unloading rails is charged to track laying and the charge of unloading ballast is charged to ballast. I think it should be the same in both cases.

The President: This report is submitted as information, and the chair would suggest that it can be handled by written discussion.

Mr. Christian: Last year, in the proceedings of 1916, the committee gave a detailed description of the various crossings. We have no further information to add this year, and we recommend that at the present this be discontinued. Under topic regarding and reporting cost of additions and betterments, the committee submits four tentative forms, and asks consideration of these plans. I will ask Mr. Sattley, chairman of the sub-committee, to explain these four forms.

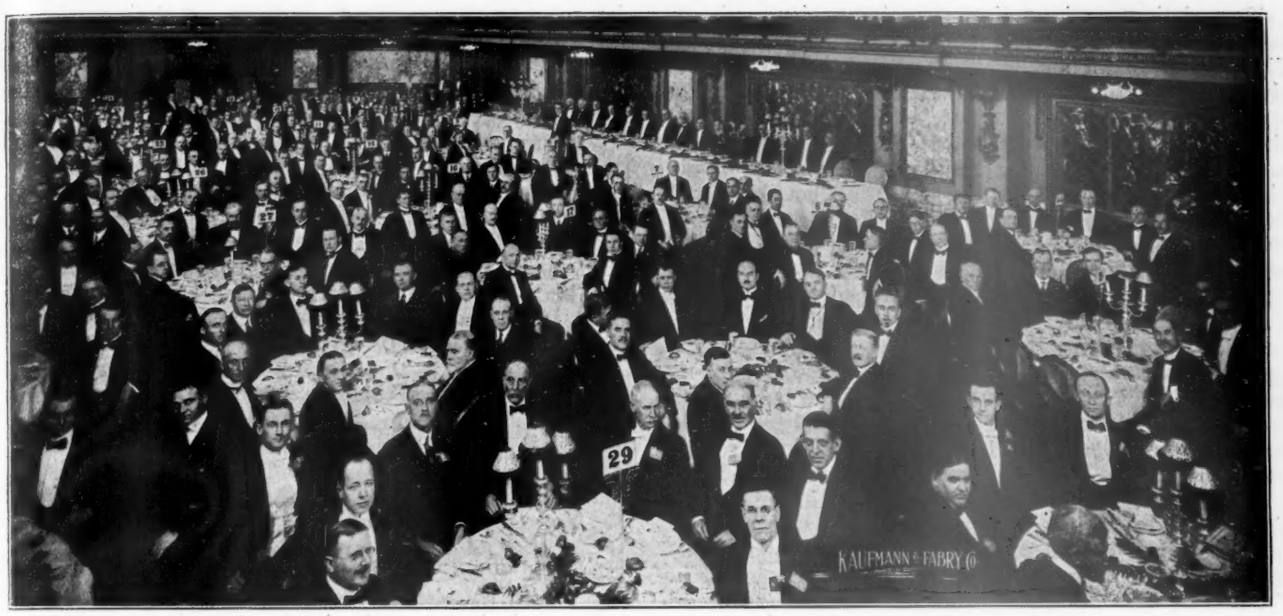
R. C. Sattley (C. R. I. & P.) explained these forms at considerable length, and they were received as information.

Mr. Christian: The sixth subject is next (reading sixth subject). The committee would be pleased to receive any criticism the committee may have to make, but this is quite a long subject to discuss on the floor.

The President: If there is no objection this will be received as information, with the request that members interested will communicate with the committee in writing, discussing these different specifications.

Mr. Christian: The seventh subject, "Report on Valuation Forms Now in Use and Recommended for Both Field and Office Use." The committee submits a number of typical blanks, and the committee recommends that these forms be adopted by the association and inserted in the manual. Since this was sent to the press we chose to withdraw that recommendation, and submit this as information.

The President: If there is no objection the forms will be received as information, and the committee will be dismissed with the thanks of the association.



Annual Dinner American Railway Engineering Association

Annual Dinner of the Engineering Association

Abstract of Addresses at the Eighteenth Annual Banquet Last Evening in the Gold Room of the Congress

THE eighteenth annual dinner of the American Railway Engineering Association was held in the Gold Room of the Congress Hotel last evening, with President A. S. Baldwin presiding as toastmaster. The speakers at the dinner included Professor William H. Thornton of the University of Virginia, who spoke on "The Basis of Professional Ethics for Engineers;" Sir William Peterson, principal of McGill University, Montreal, Que., whose subject was "Sister Democracies," and Samuel O. Dunn, editor of the *Railway Age Gazette*, who discussed "The Interest of Private Property in Railway Regulation."

Professional Ethics for Engineers

PROFESSOR WILLIAM H. THORNTON spoke in part as follows:

I belong in a small way to the group of men who are striving to teach engineering, who are attempting to lay those scientific foundations upon which all sound engineering must ultimately rest. Of all the materials which pass through your hands we send you the most precious; for we send you the young men who are to be your present aids, your future colleagues, your ultimate successors and inheritors. It is of professional ethics as it concerns these young men and their outlook upon life that I desire to talk with you for a few minutes this evening.

Prof. William H. Thornton

The engineer stands in a relation to the persons with whom and for whom he must work which has no exact parallel in any other profession. He stands between two parties: client and contractor. The two have mutual duties, each to the other; mutual interests to be guarded, mutual rights to be enforced. There is a contract with its specifications, and if these have been properly drawn there is no real conflict in these rights and duties. The business of the engineer is to interpret that contract and so to interpret it that wrong shall be done to neither side. He owes allegiance to both parties, must consider the interests of both, must guard the rights of both.

To his client he is not a mere hireling, working for a fee, but rather a skilled adviser who has accepted an important trust. He must hold himself clear from all conflicting engagements, he must decline all commissions which might blind him to his client's interests, he must not specify even his own inventions, although the best for the purpose in view, unless the client, on the basis of other expert advice, gives his clear assent.

With the contractor he must be not simply fair, not simply courteous, but helpful, liberal with counsel, generous in the interpretation of contract requirements, but also scrupulously just. Above all things, he must remember that the first and last and best virtue of an umpire is impartiality. Contractors must be treated like human beings to get the best results; but all engineers, and especially young engineers, need to be guarded in their dealings. To abandon the heights of impartial justice is fatal.

The relations of the engineer to other engineers should be governed by the conception of a common professional dignity and distinction, in which all reputable engineers share alike. Distrusts, animosities, open hostilities destroy public respect for a learned profession. There should instead be mutual courtesy, mutual confidence, mutual co-operation. As consultants, engineers should aim to be helpful in counsel, slow to condemn, quick to commend. To younger men especially the attitude of their seniors should be sympathetic and loyal; for this attitude more than any other will win the young to nobler views of professional duty and professional honor.

The relation of the engineer to the public ought to be guided by the sense that at some time in his career and perhaps in some great matter he may be called upon to guard the public welfare. When the call to public duty comes it should find him ready; with clean hands ready to devote whatever of wisdom and counsel and strength may be in him to the public service.

One thing more, perhaps, ought to be said concerning the relation of the engineering profession as a whole to public affairs. In this country more than in others, cities, counties, states, the nation has been exploited in the past by men who put private interest above the public good. The moral sense of our people rose in revolt against such gross abuses and for the present, and we trust for the future, the evil has been stayed; but in a land so rich in undeveloped resources, peopled by a race intent rather on fresh conquests than on conservation, new developments of these old diseases may in time recur. One feature has been common to all these predatory wars on community wealth: the men who organized them and profited by them utilized the mercenary services of professional experts, both lawyers and engineers, without whose aid success would have been hardly possible. To me it seems the gravest indictment, which can be brought against these two professions in America, that in their corporate capacities they have condoned these crimes.

In the school with which I have the honor to be connected an educational experiment of profound interest and importance has been carried to successful conclusion. Early in the history of this school certain members of its faculty revolted against the universal belief that college students needed to be watched to make them honest. A resolution was adopted requiring each examination paper to be signed under pledge and espionage in every form was abandoned.

The students welcomed the reform gladly, and of their own volition without official suggestion of any sort constituted themselves the guardians of the new system. They called it the honor system, because under it the validity of a student's papers rested solely on his pledge given under honor that in the composition of the papers he had been perfectly fair. The system has been gradually extended until it embraces not only the examinations, but almost all the relations of the students to the university and to each other. The faculty has learned to leave all these matters to the students, who, through their honor committee, handle them with such knowledge and insight as no body of professors could possess.

A little anecdote may make clearer to you the way in which the tradition of this system grips the imagination of young men. A few years ago two very decent appearing fellows came into my office and asked to be registered in the junior class in mechanical engineering. I asked where they had studied; they gave me the name of the school, told me that they had left it in good standing, as their credentials would show, and had come to Virginia for special and personal reasons. I made out their registration cards, sent them to interview their professors, and told them to report the next morning with their cards properly countersigned and their credentials from the other college. When I reached my office they were waiting for me, but instead of completing their registration they asked to cancel it. When I inquired the reason for their change of purpose, they told me that they had attended a mass meeting of the students held the night before. At this meeting the purposes of the honor system and its mode of operation had been explained, speeches had been made about it by students, and old students had discussed with the new men its general conduct and results. They returned to their hotel, talked matters over, and concluded that Virginia was no place for them. They had been members of a Greek letter society at their former school, had been mixed up in some scandal relating to its treasury, and had been advised by friends in the faculty to go to work in a factory for a year and then return for their degrees. Thinking to save a year of time they had come to Virginia, but had found hostile conditions. "If we entered here," they said, "we should never have an easy hour. If our story leaked out, the honor committee would be sure to fire us."

From Virginia this honor system has extended to the colleges in the southern states. It has been introduced into Princeton University, while other northern and western schools have adopted it, or are considering it. We do our best in training our young engineers to have them lay deep and solid the great cornerstones of all applied science—mathematics and mechanics, physics and chemistry. We strive to give them secure possession of the principles of engineering, so that in professional life they may at least know how and where to begin the assault upon the perplexing problems that must confront them. We do not delude ourselves, however, as to the measure of success we are able to attain. We know that it is most modest, and that when they pass from our hands to yours they are just beginning to learn what in the school of practice you must teach. But in the matter of character we feel that they come to you unspoiled—honest and loyal and true. Emerson said once of the religion of our grandsires, the religion of a hundred years ago, that it was "an iron belt to the mind, giving it concentration and force." Our aim is to give these young soldiers, who are to enlist in your army, the weapons of their warfare and to teach them to keep these weapons sharp and use them aright; but above all to keep alive in them the spirit of honor—reverence for honesty and truth and loyalty and courage—knowing that this is not only armor for the soul but an iron belt to the mind.

Shall I be trespassing on your patience if I commend these young men to your interest and your care—not ours alone, but the graduates of all the schools, who from year to year aspire to enlist under you as their captains and leaders? For whatever differences may appear in the methods of our various institutions, our objects are everywhere the same.

The foundation of the ethics of our profession is laid in personal character; codes can do no more than formulate the features dominant in the human soul. We collegians begin the work and our aim is to send to you men of trained intelligence, imbued with the scientific principles of engineering, eager to learn the practice of their profession, not afraid to labor at beginner's tasks, but above all men who reverence right and truth and duty and loyalty. We commit them to your hands, realizing that you also have a great work to do for them.

The Interest of Private Property In Railway Regulation

MR. DUNN spoke as follows:

For many years, and especially during the last ten years, the people of the United States have been trying to solve the problem of establishing satisfactory and beneficent relations between the railways and the public. All understand that this is a problem of vital importance. The policy followed in dealing with it will have not only direct, but also indirect effects of the greatest moment.

Samuel O. Dunn

Much emphasis has been placed on the importance of the direct effects which will be produced. Many times it has been pointed out that unless those who invest capital in railways are justly and wisely treated the development of our transportation system will be interrupted, and that the results of this must be to arrest the development of our industry and commerce, and to blight the prosperity of our people.

The soundness of this argument has been illustrated by recent events. We have seen the almost complete cessation of the construction of new railway lines. We have seen existing lines burdened with a traffic too great for them to carry. When we look about for the cause we recall that only eighteen months ago there were more miles of railway in the hands of receivers in this country than ever before. When we seek for the cause of that, we find that in 1914 and 1915, after eight or nine years of our present policy of regulation, the railways of the United States were able to retain, after defraying their operating expenses and taxes, a smaller part of each dollar they earned to be used in paying their interest and dividends, and in making improvements, than had ever been the case before in history. We find also that in those two years they earned the smallest percentages of return on their investment since the panic period of the 90's.

The relationship of cause and effect here is direct and certain. Regulation cannot unduly restrict the net earnings of the railways without directly so hampering their development as to render them unable satisfactorily to handle the commerce of the country. There has recently been a large increase of earnings; but the same forces which in the past have caused a decline in net return are still in operation; and so long as they continue to operate they will produce the same effects as heretofore.

While, however, emphasis should be put on these direct and immediate effects of the policy of our government in dealing with the railways, we must not overlook the fact that it will also have, in the long run, indirect effects which may be even more momentous. The indirect effects to which I refer are those which will be produced upon the status of other private property, and upon the rights and interests of its owners.

An attempt is made by many to draw a sharp distinction between railways and public utilities and other kinds of property. Some even call railways and public utilities "public property." But the courts have clearly defined their status. They are "private property affected with a public interest." Because their service is affected with a public interest government may regulate them; but it has no more right to so regulate them as to destroy the property rights of their owners than to destroy the property rights of the owners of other property; and the effects upon the public of destructive regulation of them are bound to be the same as those of such regulation of other property.

How Railway Regulation Will Affect Other Property

How will the way in which the railways are dealt with affect the status of other private property, and the rights and welfare of its owners? One of the most unavoidable and important ways in which it will affect them will be by the establishment of good or bad precedents. We all realize the effects produced by the establishment of good or bad precedents by the courts. Unfortunately we do not all appreciate that statutes passed by our law-making bodies, and acts done by the executive departments of our governments, also establish precedents having far-reaching results.

The point which I wish to emphasize has been fully and clearly elaborated by Prof. A. C. Dicey in a brilliant book written some years ago, entitled "Law and Opinion in England." We all know that public opinion often makes law. Prof. Dicey showed how law also makes public opinion. When we pass a law or establish an administrative rule or system to deal with a particular kind of industry or a particular class of property we inevitably foster a public opinion which will not only favor more and more government interference with that particular industry or class of property, but we create a public opinion which will favor dealing with other kinds of industry and other classes of property in a similar way.

That is precisely what has been occurring in the United States. When regulation of railways was begun it was intended chiefly to eliminate unfair discriminations in rates. We have seen it increased within the last ten years until it now extends to rates, operation, equipment, finances, the purchase of supplies and, finally by the enactment of the Adamson law, to wages.

The precedents established in the regulation of railways already have had widespread effects. We have seen administrative regulation extended over manufactures by the creation of the Federal Trade Commission. The Interstate Commerce Commission had no more power when it was created than the Federal Trade Commission has now; how many years will it be before the Federal Trade Commission will have acquired as much power over manufactures as the Interstate Commerce Commission now has over railways? We have seen the Federal government begin to tax, and thereby to some extent limit and control, the so-called "excess" profits of all kinds of corporations. We have seen the authority of commissions originally created merely to regulate railways extended over all other public utilities; and recently we have seen bills introduced and seriously considered in state legislatures to still further extend their authority over every class of concern whose business in any substantial degree affects the welfare of the public.

Such developments show that it is futile to spin fine theories regarding the difference between public utilities and other classes of property, and to base upon them arguments in favor of special and drastic regulation of

public utilities. The public, whose opinion determines how all property shall be dealt with, does not understand, or it ignores, these theories. Public opinion does not work along scientific lines. It works along empirical lines. When it has taken control of railway rates, and the price of coal advances, it says, "Since we control railway rates, why should we not also control the price of coal? Is transportation any more of a public necessity than fuel?" When the price of food goes up it says, "Surely, there is as much reason why the government should control the price of food as why it should control the price of transportation or coal. Is transportation any more of a public necessity than food?"

Since the kind of regulation we apply to railways is certain largely to determine the way in which our government will deal with other kinds of property, it behooves us to take great care what kind of precedents we establish in the regulation of railways. Now, there can be no serious question that the present tendency of our regulation of railways is to reduce the protection afforded to private property and to encourage unfair and destructive attacks upon it. I could cite much evidence in support of this view, but I must confine myself to a few illustrations.

Arbitrary Passage of the Adamson Law

One of these is afforded by the precedent set by the passage of the Adamson railway wage law.

The Supreme Court has held that Congress had the constitutional power to pass that law; but whether Congress had the power to pass it, and whether it ought to have passed it, are two entirely different questions.

One of the principal measures of the progress of civilization is the extent to which reason is substituted for force in the settlement of disputes between individuals, groups of persons and nations. The labor brotherhoods by their course in the recent controversy said in substance that as a means of settling controversies between them and the railways reason is played out, and that therefore they must revert to force. The doctrine that workingmen should rely solely on force to get what they want is not an entirely new one. It is the fundamental principle of syndicalism in Europe. It is the fundamental principle of I. W. W.-ism in the United States. The government of the United States by countenancing instead of condemning this barbarous principle, by legislating to give it effect, instead of to prohibit it from being given effect, has set a precedent which, unless soon reversed, will spell disaster to every class of our property and our people.

We all know that the Adamson law was not intended to regulate the hours of work of railway employes but to increase their wages. Now, it may be that government machinery should be provided for investigating and even actually fixing conditions of employment and wages in the railway and some other industries. There is no more difficulty in determining a reasonable wage than in determining a reasonable rate. But the regulation of wages by experts after full hearings and investigation, and their regulation by arbitrary laws passed without any investigation are two entirely different matters. There is no more justification for Congress thus arbitrarily to advance the wages of railway employes than for it or any state legislature arbitrarily to advance the wages of any other class of workingmen.

Effect on Disputes in Other Industries

Disputes between employers and employes are not confined to the railroad business, nor is the railroad business the only one in which a nation-wide strike would be disastrous to the public, or in which there are labor organizations numerically powerful enough to give them great political influence. There may soon be the threat of a general strike in the coal mines, for example. Will Congress then pass a law arbitrarily advancing the wages of the mine workers? And if great labor disputes are to be settled by force, or by legislation advancing wages for political reasons and without any regard to the ability of property owners to pay them, what has become of the rights of property, which always have been regarded as among the foundation stones of our institutions?

The passage of the Adamson act has had one beneficent result. The Supreme Court, in deciding the case resulting from its enactment, not only held that it was constitutional, but also expressly held that Congress has power to use any appropriate means for preventing interruptions of transportation service, including the passage of legislation providing for compulsory arbitration. The only way for Congress to forestall the evil effects likely to be produced by its ignoble surrender to the labor brotherhoods last September is, at its next session, to pass a law prohibiting strikes on railroads and providing for compulsory arbitration of railway labor disputes; and surely in view of recent developments the public's demand for such legislation will be so overwhelming that Congress will have to pass it.

Will the Federal "Valuation" Destroy Value?

In dealing with the labor controversy on the railways the government has been dealing with the question of what wages the railways should pay to their employes; and without investigation or hesitation it increased their wages $60,000,000 a year. In making a valuation of the railways the government is dealing with the question of what profits the companies shall be allowed to earn; and we find it manifesting a disposition to be far less generous in its treatment of those who have made investments in railways than in its treatment of those whom the railways employ.

Valuation as a basis for the determination of the reasonableness of rates was originally adopted by the courts to protect the property of railways from being confiscated in violation of the Constitution of the United States. The courts held that to require a railway to accept rates which would not yield a fair return upon the fair value of their property was, in effect, to confiscate the property itself. They made clear that what they meant by "fair value" was the same thing they meant by that term when they used it to indicate the measure of what must be paid for property taken by condemnation for public use.

After this principle was adopted by the courts it commenced to be criticized by agitators against railways, because they began to fear that its application would result in much higher valuations being made than they had anticipated. They have advanced such contentions as that the railways are not entitled to have included in their valuations value which has been created by investments from earnings, or by the natural increment in the worth of land, or by donations made by individuals, municipalities, states, or the national government; they have denied the right of railways to have going value included in their appraisals, and so on. Now, it is obvious that if large and important elements of value are to be excluded, no real valuation will be made. The so-called valuation will become merely an attempt to find not what

the real value of railway property is, but what, on certain new novel economic theories, it ought to be.

The railway managers have been startled recently to find that the Department of Valuation of the Interstate Commerce Commission seems to be disposed to accept some of these theories. The law providing for the valuation seems to have intended that the tentative valuations which the Commission is required to make should be complete, and should therefore include every element of value. In the tentative valuations, which have been submitted, however, no appraisal has been placed in some cases on land which has been donated or acquired for a nominal consideration; severance damages which the railways have paid and would have to pay now if they were acquiring land have not been allowed; there have been no allowances for going value; and, while large deductions have been made because of alleged depreciation from the estimated cost of reproduction of the properties, allowances have not been made for the appreciation in the value of the physical properties, which everybody knows takes place after a new railway is put into operation.

Perhaps these tentative valuations should not be regarded seriously, but should be treated as having been merely presented to afford a basis for discussion of the methods and principles finally to be adopted. But, if they do indicate the action finally to be taken the situation is serious. The adoption of such methods and principles would not tend to ascertain, but to destroy a large part of the value of the railroads. Our drastic policy of regulation already has seriously reduced the expansion of transportation facilities. A valuation on such principles would make regulation still more destructive.

Other Property Also Object of Attack

Railway property is not the only kind of property which is the object of attack in this country. The single tax movement, for example, is in effect a movement for the confiscation of the value of all land—the land of the farmer as well as that of the owner of real estate in cities and of the railway. The very phrase used to justify exclusion of the value of certain land of the railways—viz., "unearned increment"—is borrowed from the vocabulary of the single tax propagandist. What better precedent could the single taxer want for the confiscation of the so-called "unearned increment" in other land than its partial exclusion from the valuation of the railways? The most comprehensive attack of all on private property is that made by the socialists; and if we once set the example of confiscating any kind of property, where are we going to find a logical place to stop short of socialism itself?

It may be said that the views I express are unduly alarming. But I call your attention to the fact that there has never been a time in the history of this country when there has not been some kind of warfare being waged against fundamental property rights of one kind or another, and that these attacks have not always been unsuccessful. The fiercest opposition to the adoption of the federal Constitution proceeded from persons who had become involved in debt, and who feared that the establishment of a strong central government would tend to force them to meet their obligations. At a later period many of our states became practically or actually bankrupt, and there was an organized agitation for the repudiation of their debts, and in some cases these agitations were successful. Again, after the Civil War there was a powerful agitation in favor of the maintenance of an inconvertible paper currency by persons who did not want to be forced to pay their debts in real money. Only twenty years ago we had the most bitter political struggle known to this generation over the question of whether all outstanding debts, public and private, should be reduced to 50 cents on the dollar by the adoption of the silver standard for our currency.

The agitation which has been conducted by certain politicians to confiscate part of the value of railway property is a movement of the same character. Those who have invested their capital in our railroads have done so on the implied assurance that railway property would be treated with the same consideration as other private property; and to make a valuation which would ignore some of the important elements of value entering into railway property would be merely a new form of repudiation of debts.

Public Opinion the Deciding Factor

I do not believe the courts would approve a valuation which tended to confiscate a large part of railroad property. But within recent years we have seen even the Supreme Court of the United States render many decisions which it would not have rendered 10 years before. Furthermore, there is a force greater than courts or constitutions. That force is public opinion, and once an effective public opinion is created in favor of treating one class of private property unfairly it will be but a short time until an effective public opinion can be created in favor of treating other kinds of private property unfairly; and once there is created a public opinion actively hostile to the rights of private property, courts and constitutions will no longer be able to protect them.

Some will think that I put excessive emphasis on the "rights of property" and disregard the more important "rights of man." Well, in their attitudes toward matters of this kind, people are roughly divisible into three classes: On the one hand, there are those who believe in private property as an institution. They believe in it because they think that property will be more efficiently managed, and that the progress of society and the general well-being will be better promoted, under the system of private ownership than under the system of public ownership of property. On the other hand, we have the socialists who advocate the public ownership of all property devoted to production, distribution and exchange. They believe that property of practically all kinds will be better managed and the general welfare will be more effectively promoted under the system of public than under that of private ownership. Between these two classes we have a third class whose members believe that only certain kinds of property, as public utilities, or coal mines, or land, should be owned by the public. There is hardly any kind of property the public ownership of which is not advocated by some group of persons.

I belong to that class of persons who believe that, assuming that both the public, on the one hand, and private owners on the other, will be given adequate protection, almost every kind of property will be better managed, and the progress of society will be better promoted, under private than under public ownership. But whether that view is sound or not, one thing seems to me very clear and certain, and that is that nothing but harm will result from an attempt to deal with property privately owned in such a way as to destroy its value to its owners. Unless the government deals fairly between labor and capital, unless the owners of private property are allowed to benefit by increment in its value and by increases in its profitableness due largely to the energy and enterprise which they show in managing it, the incentive to enterprising and efficient management of property will

be destroyed. If the incentives to enterprising development and management of property are destroyed, and at the same time it is left in the hands of private owners, we shall have all the disadvantages of the systems of private ownership and of socialism, and none of the advantages of either. And if this is to be done in the case of railway property, we cannot rationally expect that it will not be done in the cases of other kinds of property when they become, as they are certain to become, the objects of similar attacks.

In every country and in every age there is always a struggle going on to prevent the rich from grinding the faces of the poor, or to prevent the less industrious and thrifty classes of the community from seizing upon and enjoying the fruits of the labors and the self-sacrifice of the industrious and thrifty. Oftentimes these two struggles go on side by side. They are going on side by side in our country now. Most of our social reformers and our politicians apparently see only the menace to the general well-being presented by the avarice and the cunning of the few. But, under a system of universal suffrage, which permits the masses, if they are disposed to do so, sometimes to abuse and sometimes to defy the power of government, there may be as great a menace to the general well-being in the cupidity and ruthlessness of the many as in the avarice and cunning of the few. The chief difficulties formerly presented to the solution of certain of our great economic and social problems, and especially of our railroad problem, were the unscrupulousness, the avarice and the cunning of the few. At present the chief difficulties in the way of the solution of the railroad problem, at least, are the cupidity and the ruthlessness of certain large classes of our people and the activities of politicians who encourage and represent their cupidity and ruthlessness.

An able and vigorous effort is now being made to get our system and policy of regulation of railways so strengthened, and at the same time so modified that they will cease to be destructive of the rights of the owners of the railways and of the general well-being. If that effort fails, the harm done by its failure will in time be felt by every class of our people; and on the other hand, if it is successful the benefits directly and indirectly conferred will be shared by the owners of every kind of property, by all classes of our people and by future generations.

Sir William Peterson on "Sister Democracies"

SIR WILLIAM PETERSON spoke in part as follows:

"What message could one have to a gathering such as this that has not some relation to the events of the day? The present world convulsion presents, it seems to me, many points of view, from which I might try to engage your attention, but there is only one fact on which I shall try to refer to it tonight. The text is set down opposite my name, 'Sister Democracies.' You will be acquainted with what I mean when I begin by saying that I hope you are all equally interested with me in the hope and in the confident expectation that, when this world convulsion is over, the principle of democracy, the principle that government shall be by the consent of the governed, by the governed, shall not have perished from the earth.

Sir William Peterson

"There is a line of action that is likely to open up in the region of practical affairs on the second of April next, and it is probable, in my humble judgment, that such action will conduct us towards a solidarity of English-speaking peoples which will become the most potent instrument in the peace and prosperity and progress of mankind.

"In this Canada surely has a role to play. She is, as it were, the intermediary between your great country and the old land. A statesman of Canada once said that Canada stood between these two great nations, whose blood she shared, to moderate their counsels and preserve them in the bonds of peace. Today her mission is the same. She can make England understand that our differences are only skin deep. For 21 years it has been my pride and privilege to revisit every summer my home, and I can do something as a Canadian to explain to the people of the old land, that the differences which are so apt to appear striking to them, are really differences which are only skin deep.

"Canada can help the old land to understand the mental attitude of American citizens, especially in the realm of political and social thought, and she can also help your citizens to appreciate the fact that the last word on the ideals of free government has not yet been spoken even by the great Republic, and that it is possible for a state, even though nominally under monarchial influences, to enjoy institutions fully as free and liberty, public and private, fully as unrestricted as anywhere under the Stars and Stripes. That is the mission of Canada in war and in peace.

"The great compensation that is coming to us has come to us in the condition in which the United States fortunately now stands in regard to this conflict—the great compensation is that it is going to bring Britain and America nearer to each other in mutual sympathy and understanding. We have the same ideals of liberty, the same sense of individual freedom, for which both you and I would be willing to go, if necessary, to the stake. We have both the same sincere desire to co-operate in the diffusion throughout the world, so far as we may be permitted to do, of a better and higher civilization. Pray God that in the coming time your efforts in sympathetic union with the old country, with the efforts of the allied peoples, may result in a peace that shall be worthy of such a war as that which we have been waging, a peace which will guarantee security to the world for the rest of this Twentieth Century, and my fervent hope is that that peace will not be disturbed for hundreds of years to come."

THE LAST DAY OF COLISEUM EXHIBIT

Following the practice established last year the exhibit at the Coliseum will close tonight. Many railway men will leave town tonight and most of those remaining will participate in the trip to Gary tomorrow, so that it is not considered advisable to continue the exhibit on Friday.

THE ELECTION OF OFFICERS

At the close of the afternoon session yesterday the results of the election of officers for the ensuing year were announced as follows:

President, John G. Sullivan, chief engineer, Canadian Pacific, lines west, Winnipeg, Man.

First Vice-President, C. A. Morse, chief engineer, Chicago, Rock Island & Pacific, Chicago, Ill.

Second Vice-President, Earl Stimson, engineer maintenance of way, Baltimore & Ohio, Baltimore, Md.

Treasurer, George H. Bremner, district engineer, division of valuation, Interstate Commerce Commission, Chicago, Ill.

Secretary, E. H. Fritch.

Directors: J. A. Atwood, chief engineer, Pittsburgh & Lake Erie, Pittsburgh, Pa.; W. H. Courtenay, chief engineer, Louisville & Nashville, Louisville, Ky.; L. A. Downs, general superintendent, Illinois Central, New Orleans, La.

Members of the Nominating Committee: J. R. W. Ambrose, chief engineer, Toronto Terminal Railway, Toronto, Ont.; George H. Burgess, valuation engineer, Delaware & Hudson, Albany, N. Y.; W. M. Dawley, assistant engineer, Erie, New York, N. Y.; V. K. Hendricks, principal assistant engineer, St. Louis-San Francisco, St. Louis, Mo.; S. T. Wagner, chief engineer, Philadelphia & Reading, Philadelphia, Pa.

C. A. MORSE,
First Vice-President-Elect

JOHN G. SULLIVAN,
President-Elect

EARL STIMSON,
Second Vice-President-Elect

President John G. Sullivan

When John G. Sullivan, who was yesterday elected president of the American Railway Engineering Association, joined that organization early in 1902, he was given membership number 448. By a peculiar coincidence the holder of membership number 447 is A. S. Baldwin, the man whom he succeeds as president. Mr. Sullivan's career fulfills the popular conception of what a railway engineer should be. Most of the years of his professional life have been spent in the location and construction of railroads in northwestern United States and in western Canada, and he has been for a number of years the chief engineer of one of the most important railways in North America, the Canadian Pacific, lines west. A further appeal to popular imagination is to be found in his experience as assistant chief engineer of the Panama Canal Commission during the railway regime, and as the builder of the Connaught tunnel, the longest railway tunnel of the western continent.

As a locating engineer in rugged western country, he experienced hardships which bring a richness of life denied to the young engineers of this time. Mr. Sullivan's friends enjoy telling how he started out from camp one cold winter night on what he thought was a 12-mile walk through a mountain canyon to the railway station, in order that he might spend Christmas day with his wife. After stumbling along all night, and falling into the mountain stream several times, he arrived at the station and learned that he had walked 30 miles instead of 12.

John G. Sullivan was born on June 11, 1863, at Bushnells Basin, Monroe County, N. Y. He graduated from Cornell University in 1888, and began railroad work as a rodman on the Great Northern. The following year he entered the service of the Spokane Falls & Northern, now a part of the Great Northern, as instrument man and assistant engineer. Later he became assistant engineer on the Great Northern, and in 1890, assistant engineer with the Alberta Railway & Coal Company. He was made locating engineer for the Butte, Anaconda & Pacific in 1894, and in the succeeding year was appointed principal assistant engineer of the Kaslo & Slocum. Between 1896 and 1900 he was in the employ of the Columbia & Western, now a part of the Canadian Pacific, serving first as a reconnaissance engineer and later as principal assistant engineer in charge of construction and operation. The next five years found him with the Canadian Pacific as division engineer in charge of all new construction on the western lines. When John F. Stevens became chief engineer for the Isthmian Canal Commission, in 1905, Mr. Sullivan accepted the position of assistant chief engineer, going to Panama in September, 1905, and returning in 1907, when he became manager of construction of the eastern lines of the Canadian Pacific. In September, 1908, he was appointed assistant chief engineer of the eastern lines, and in February, 1911, he was transferred to the western lines in the same capacity. His advancement to chief engineer, the position which he now holds, took place eight months later.

PROGRESS IN THE VALUATION HEARING

By Our Washington Correspondent

Washington, March 21, 1917.

E. Holbrook, special engineer on valuation for the Union Pacific, W. H. Courtney, chief engineer of the Louisville & Nashville, and J. E. Willoughby, chief engineer of the Atlantic Coast Line, testified on Tuesday in the hearing before the Interstate Commerce Commission on the protests filed by the carriers against the tentative valuations of the Kansas City Southern, the New Orleans, Texas & Mexico, and the Winston-Salem Southbound. This hearing has been in progress since Monday.

Mr. Courtenay presented figures showing the cost of maintenance on the various lines recently built by the Louisville & Nashville as compared with the cost of track maintenance on the older lines of the system. This showed that the cost on the newer lines was materially greater than on the lines which had attained an age under which solidification and seasoning had thoroughly matured. He stated that it was impossible to give more than an approximate value for appreciation and that there is no mathematical process by which it is possible to secure accurate results. He said further, that experience had shown that 25 per cent of the cost of grading represents the difference between a seasoned line and a new line. As examples of the items which make up this difference he called attention to the fact that the freedom from derailments on a seasoned line reduces the cost of operation and that seasoning has more effect on the tonnage rating than slight differences in grade.

In answer to a question as to the factors making up the value of appreciation, Mr. Willoughby mentioned the lessened cost of maintenance, the greater speed of trains, increased tonnage rating and reduced operating hazard. He confirmed Mr. Courtenay's testimony in fixing the valuation of appreciation as approximately 25 per cent of the grading cost of a new line.

Mr. Willoughby continued his testimony Wednesday. He said his experience in charge of construction of 1,000 miles of line showed that 5 per cent of the total amount of road accounts is a fair average allowance for engineering expense. D. J. Brumley, valuation engineer of the Illinois Central, gave similar testimony regarding appreciation, and Hollis Rinehart testified regarding the contingencies which are usually encountered in construction, saying that 10 per cent was a fair average allowance for this, but that he had known of cases in which unforeseen contingencies amounted to as much as 50 per cent. Wesley Lane, another contractor, gave examples of contingencies he had encountered in construction work on which he had been engaged, which in some cases had doubled the cost of the work, although in many cases the difficulties which he had encountered would not be noticed in the valuation of the property years afterward in cases where the original records were not preserved. He said, further, that he had never taken a contract without an allowance for contingencies and that in one case an unforeseen flow of mud encountered in a tunnel that was presumably through solid rock had increased the cost from $500,000 to $1,000,000.

REGISTRATION—AMERICAN RAILWAY ENGINEERING ASSOCIATION

Adamson, J. H., Field Engr., B. & O. R. R., Meyersdale, Pa.
Andrews, Geo. W., Asst. to Engr. M. W., B. & O. R. R., Baltimore, Md.
Atwood, J. A., Chf. Engr., P. & L. E. R. R., Pittsburgh, Pa.
Backes, W. J., Engr. M. W., N. Y. N. H. & H. R. R., New Haven, Conn.
Baisinger, W. C., Div. Engr., Santa Fe Ry., Marceline, Mo.
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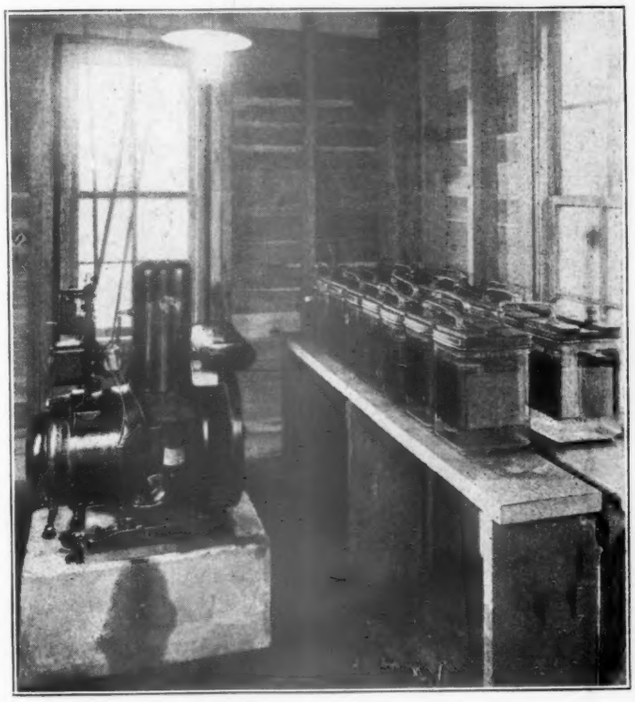
A COMPACT ELECTRIC LIGHT PLANT

The Louisville, Henderson & St. Louis recently made a marked improvement in the lighting of its station and other buildings at Irvington, Ky., by the installation of a small, compact electric light plant, designed especially for such installations. Irvington is a division headquarters on this railroad, and in addition to a combination passenger station and hotel, the road has a roundhouse, coal elevator, freight depot, carpenter shop and a number of other buildings. Previous to the installation of the electric light plant, oil lamps were used for lighting the buildings and oil and kerosene torches for work around the engine terminal. The old method of lighting was not only unsatisfactory but also expensive. The six gasoline torches used burned about 20 gal. of gasoline per week and the repair expense amounted to about $15 per month. With the new system, electricity for 31 Mazda lamps ranging from 20 to 50 watt size is supplied by a gasoline engine generator set which uses only about one gallon of gasoline per week. The attendance required by this plant is practically nil, and thus far the maintenance has been very small.

The plant at Irvington is one of the Delco light plants, manufactured by the Domestic Engineering Company of Dayton, Ohio. These plants are designed especially to supply current for electric light or other purposes for small or moderate demands where current from a public utility is not available.

Simplicity of construction and operation is the keynote in the design of this type of plant. A book of



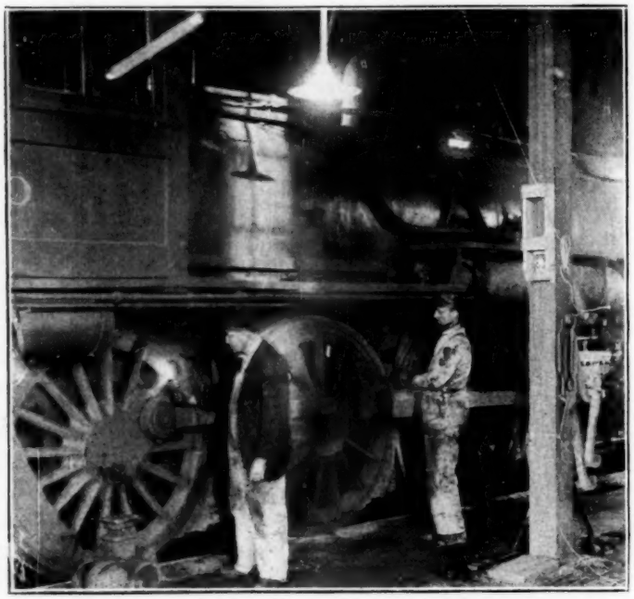
A Gas Engine Generator and Battery

instructions is issued by the manufacturer which makes the operation so clear that the plant may be readily run by one not versed in electrical engineering. The engine and generator are direct connected, being mounted on a single shaft carried on the same frame and bed. Both engine and generator are covered by a single outside casing and the switchboard is mounted directly over the motor. An air-cooling system is provided for the entire plant by means of a fly-wheel fan on the end of the shaft, which draws air through the casing from inlets in the ends of the generator and engine cylinder covers. The main shaft is mounted on two bearings, one equipped with New Departure ball bearings and the other with Hyatt roller bearings. The engine is a single-cylinder, four-cycle, valve-in-head type engine, with a gasoline tank mounted on a bracket supported from the side of the cylinder cover.

The generator supplies direct current at 32 volts and the switchboard provides for practically automatic control. In starting the generator runs as a

motor from current supplied by a 12-cell storage battery until the speed has built up to an extent to start the gas engine and have it running at normal speed. The generator then runs as a dynamo, producing current to charge the storage batteries and continues to run until the batteries are fully charged, when an automatic cut-out switch stops the engine.

The batteries consist of 16 cells at 32 volts pressure in two sizes, one for 80 ampere hours and the other for 160 ampere hours capacity. The charge in the battery is checked by an ampere hour meter on the switchboard and by a pilot cell containing a specific gravity indicator.



Improved Illumination in the Roundhouse

In consequence of the complete arrangement for automatic operation the plants can be run with a minimum of attendance and the maintenance expense is said to be very small.

SERVICE RECORDS OF NORTHERN WHITE CEDAR

Some very interesting data concerning the durability of northern white cedar ties, poles and posts have been compiled by the Northern White Cedar Association from information gathered from railroads and telephone and telegraph companies. The information given below is available in the shape of excerpts taken from service reports.

Northern white cedar ties were placed in the line of the Chicago, Rock Island & Pacific, between Horton, Kan., and Fairbury, Neb., in 1888, and in 1917 the reports indicate that some of these ties are still in service after 29 years. Between Gowrie, Ia., and Sibley ties placed in 1900 were still in track in July, 1916.

In November, 1915, the Chicago, Milwaukee & St. Paul removed 7-in. by 9-in. cedar ties that had been in service under heavy traffic for 14 years. These ties were protected by tie plates. On the I. & M. division in Minnesota are stretches where cedar ties have been in service over 25 years. The Duluth, Winnipeg & Pacific has cedar ties under heavy traffic in its line north of Duluth, which in 1915 appeared to be in serviceable condition after 12 years' service.

The Great Northern has cedar ties intermingled with tamarack and treated birch in the vicinity of Brevator, Minn., over which a heavy ore traffic from the iron range is moved. These ties, which are 7 in. by 7 in. in section, were placed in 1909, and in 1915 they were still in excellent condition.

The Atchison, Topeka & Santa Fe reports that cedar ties are still occasionally taken from its branch lines in Kansas that were placed when the road was built, over 25 years ago. The Grand Rapids & Indiana has white cedar ties in its Michigan lines that have been in service 25 years. Specimens of ties taken from the Chicago & North-Western lines between Powers, Mich., and Spaulding are in an excellent state of preservation after 15 to 29 years' service.

The condition of specimen ties taken from the lines of the Santa Fe and the Chicago, Milwaukee & St. Paul is shown in the photograph. Number 1, 2 and 3 are from the Santa Fe line and were removed after 25 years' service. Number 4 was taken from the track of the Milwaukee after a service of 33 years under continuous light traffic. It was taken from tangent track with gravel ballast laid with 56-lb. rail. No tie-plates were used.

The durability of northern white cedar poles equals that of the ties. The Western Union Telegraph Company has poles along the lines of the Chicago & North-Western and the Chicago, Milwaukee & St. Paul in Illinois and Iowa that were set in 1880. After 36 years of service the poles are in good condition.

The Minneapolis General Electric Company, Minneapolis, Minn., has a line of poles in Minneapolis that have given service for 26 years and are expected to last at least until 1925. Several telephone companies report having poles in use at present that have been in service 17 to 29 years.

An investigation and research conducted by the Ohio agricultural experimental station serving several states showed that the life of northern white cedar posts could be fixed at 18.4 years. The Chicago Great Western has northern white cedar posts along its right of way near Faribault, Minn., which have given 25 years of service. Other reports show posts still sound after 40 years of service.

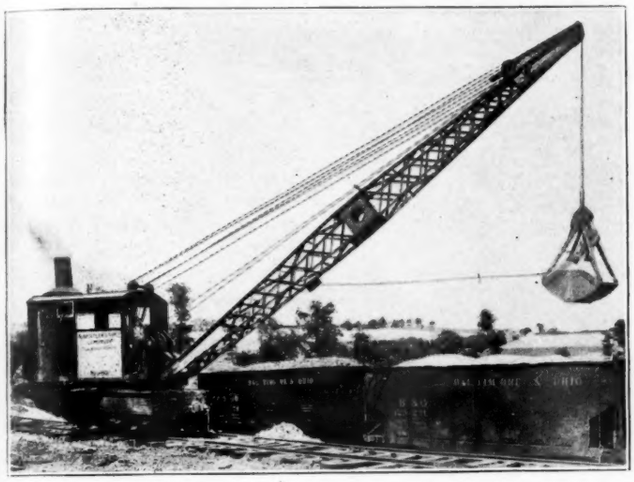
Four Long Service Ties

A UTILITY EXCAVATING BUCKET

Experience with the Blaw "E" type bucket, manufactured by the Blaw Steel Construction Company, Pittsburgh, Pa., during the past several years in many classes of service has demonstrated its adaptability for use either as an excavator or loader. It is equipped with forged steel teeth for use in excavat-

ing, but which can be removed when the bucket is to be used for unloading cars or barges. In consequence it serves as a general utility bucket that has been used for a variety of purposes. This is illustrated in the photographs.

The bucket is built entirely of steel and of capacities ranging from 1½ to 3 cu. yd. The bottom and



Unloading Broken Stone

sides are built of one continuous plate reinforced with high carbon lips, thus precluding the tearing of the scoops in excavating rock and other materials that cannot be seen by the operator. The wear at the hinge joint is practically eliminated by fitting the two

Using the Bucket as an Excavator

outer hinges and the main closing lever to the main shaft, causing the rotation due to the opening and closing of the buckets to take place on the two inner hinges. This features also holds the scoop in perfect alinement at all times.

In fundamental design, type "E" is similar to other Blaw standard type buckets. In all types the weight is concentrated below the main hinge pin when the bucket is opened, thus insuring maximum penetration at the cutting edges and eliminating top heaviness and the necessity for bracing and trussing corner bars.

A combination of the principles of the lever and the block and tackle is employed to close the bucket. The upper closing line sheaves are all located on the head pin at the intersection of the corner bars. This does away with the anchoring of one scoop and provides for the simultaneous closing of both scoops while digging.

The bell crank, or auxiliary arm, which is formed of a heavy steel casting, provides an improved type of stop and closing rope fastening. It is supported in the main hinge, furnishing a means of gradually bringing to rest the rapidly moving parts, such as the scoops or closing lever, when the bucket is being opened by reason of the stop chain becoming taut and rotating the bell crank, thus pulling out the attached end of the closing line and overhauling it clear back to the drum and causing the bucket to open without impact.

A DEVICE FOR MEASURING RAIL WEAR

A new rail profile machine for producing a pencil tracing of the exact size and shape of the head and upper part of a rail has recently been introduced by W. & L. E. Gurley, Troy, N. Y., under the name Baldridge rail contour recorder. The device has been used by the Santa Fe for several years and the graphs made by the instrument have served as a basis for the rail replacements on this road.

The instrument consists of an upright standard provided with clamps for conveniently fastening it to the rail, so arranged that it can be removed quickly to clear approaching trains. The clamp is designed to insure the section being taken perpendicular to the base and at right angles to the axis of the rail.

A sliding plate provided with clamps for fastening it when brought to the proper position is carried on the upright standard. This sliding feature permits the instrument to be used on any weight of rail. The recording device is mounted so as to be free to slide on two vertical rods, which are in turn mounted on a cross head that moves on two horizontal rods attached to the sliding plate. This gives the recorder a free motion in any direction.

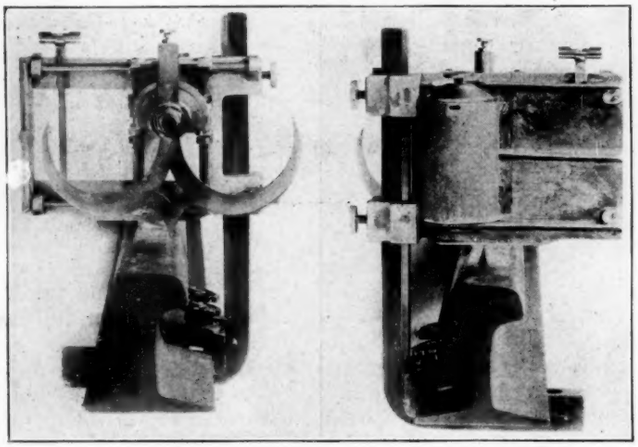
As shown in the photograph the recorder is an anchor-shaped device provided with three contact points equidistant from its axis and at right angles to each other. The tracing is made on paper drawn across the face of the plate and held in position by positive-acting clamps, thus preventing any error due to slipping or movement of the paper. The paper used is 3½ in. wide, rolled on a spool and is placed in a magazine on the back of the plate where it is protected from dirt and weather. A nut on the top of the spool provides the clamp to hold the paper in place.

The tracing pencil is carried in a sleeve or plunger which is provided with a coil spring to hold the pencil against the paper at a constant pressure and which also permits the pencil to be withdrawn, and, by a simple quarter turn, held from contact with the paper. The plunger is also easily removed from the instrument to permit of the replacement, readjustment or sharpening of the lead.

The instrument is as light as is consistent with durability, weighing but 13 lb. A convenient box about the

size and appearance of an engineer's transit box is provided for its transportation.

To use the instrument it is clamped to the base of the rail and the section of the rail is taken by bringing one of the side guide points into contact with one side of the head of the rail, and after releasing the pencil point to permit it to make a contact with the paper, moving the point downward in contact with the rail to the limit of the downward movement of the instrument. The guide points are then revolved through 90 deg. and the central point is brought into contact with and moved across the top of the rail. The third guide point is then brought into position in contact with the other side of the rail and moved down to the limit of the movement of the instrument. The movement of the guide point in contact with the rail causes the pencil to trace on the paper



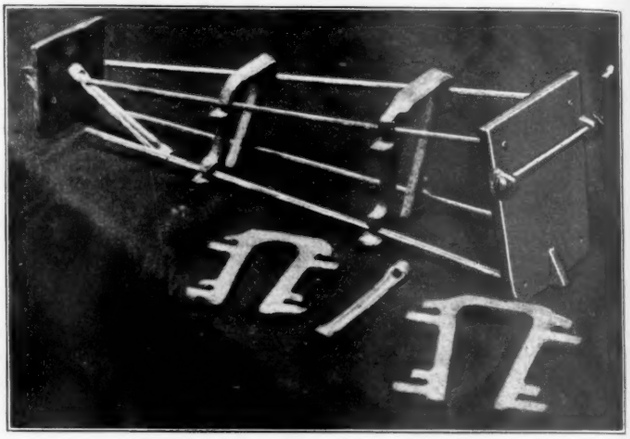
Front and Rear Views of the Machine

the exact size and shape of the rail head and the upper part of the rail. The section thus secured is transferred for comparison to a tracing showing the section of the rail as rolled.

A NEW CONCRETE FENCE POST MACHINE

A machine for the manufacture of concrete fence posts has recently been introduced which embodies a number of new features, chief among which are the manner of holding the reinforcement rods in place, the design of the agitating frames and the provisions for fastening the fencing wire to the posts. As shown in one of the photographs, the machine frame is built of structural steel and is mounted on trucks on which the frame can be moved back and forth to secure the necessary agitation of the concrete. Power for moving the truck on the frame is applied by hand to an operating lever attached to the front of the machine by links. Because the taper of the posts makes the moulds smaller at one end than the other, the frame is provided with saddles of varying heights so that the moulds can be placed with ends alternating, while having the top surfaces level. The moulds are secured in place by means of projecting points attached to the frame which enter holes in the moulds.

The moulds are made of No. 16 gage blue annealed steel formed in troughs to give the desired shape, with end gates to form the tops and bottoms secured in place by means of stove bolts. The longitudinal reinforcing rods are fixed in position at three points along their lengths. At the lower end they fit into holes in the base plate for the forms, these holes being tapered to fit rods of various diameters. At two intermediate points in the length of the posts they are secured by means of cast iron gages, which are U-shaped frames, equipped with slots in the proper positions on the two sides to engage the rods. The two lower rods are placed first and then the upper two. By pressing the tops of the gages toward the base plates the rods are locked into position, the

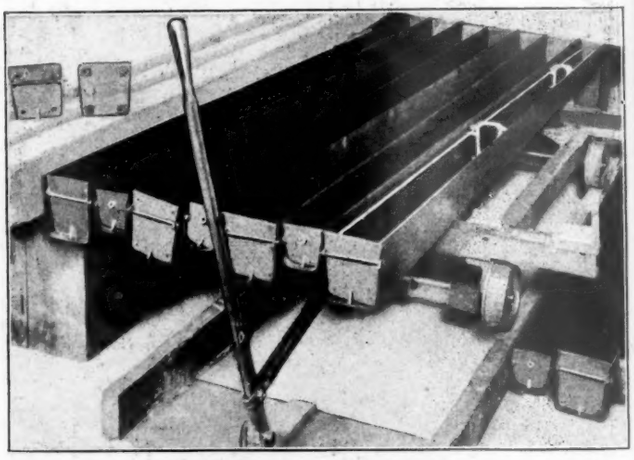


The Rod Gages and Mould Ends

tapered holes in the base plate acting as chucks to grip the rods.

With the rods in position the concrete is applied to the moulds and firmly compressed by the motion of the machine. The gages are then given a quarter turn to release them from the rods and are lifted out. The moulds are repacked with concrete at the points where the concrete was disturbed by the removal of the gages and the top surface is finished in the usual manner.

A novel provision is made in the posts built by this machine to facilitate the fastening of the wire fencing.



The Moulds on the Agitator

In addition to the usual loop around the post for securing the intermediate wires, tubes are provided through the posts at the top and also near the bottom to fasten the top and bottom wires to the post. The upper tube is placed diagonally and the lower one horizontally. The tubes consist of sheet metal pipe held in position in the form by means of 40 d spikes passing through them.

This machine is made by the "P. & I." Post Mould Company, Marion, Ind.